OIPE
JAN 20 2004
PATENT & TRADEMARK OFFICE

Today's Ethernet

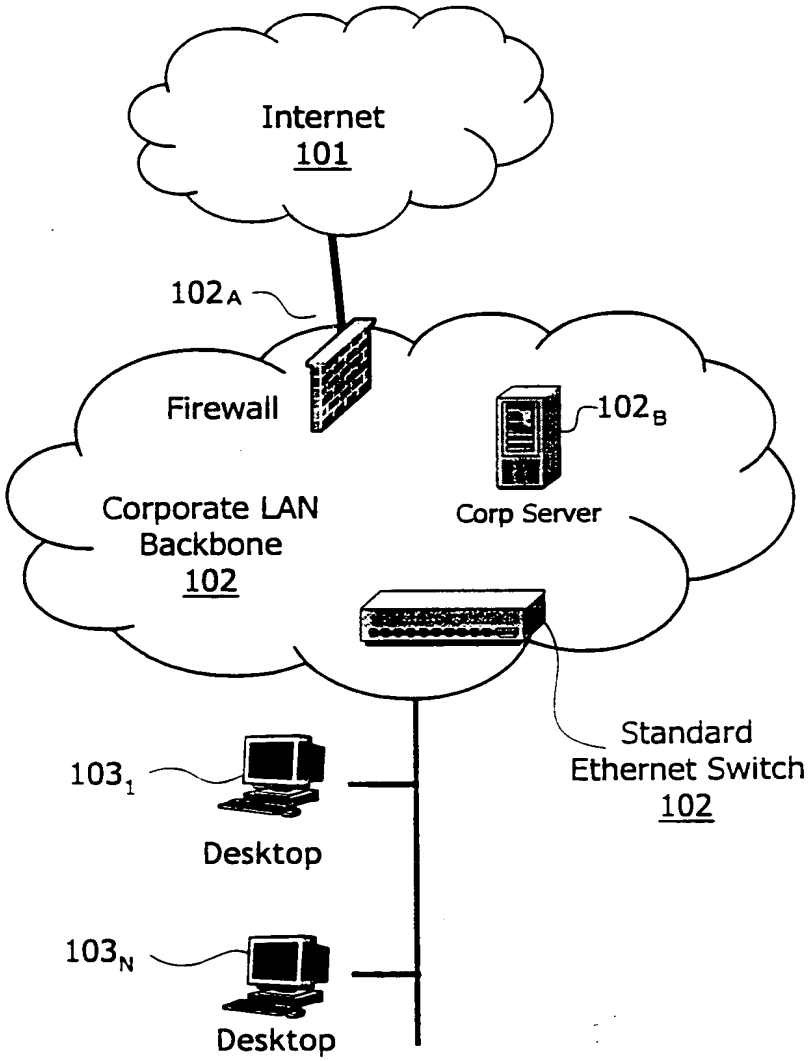


FIG. 1

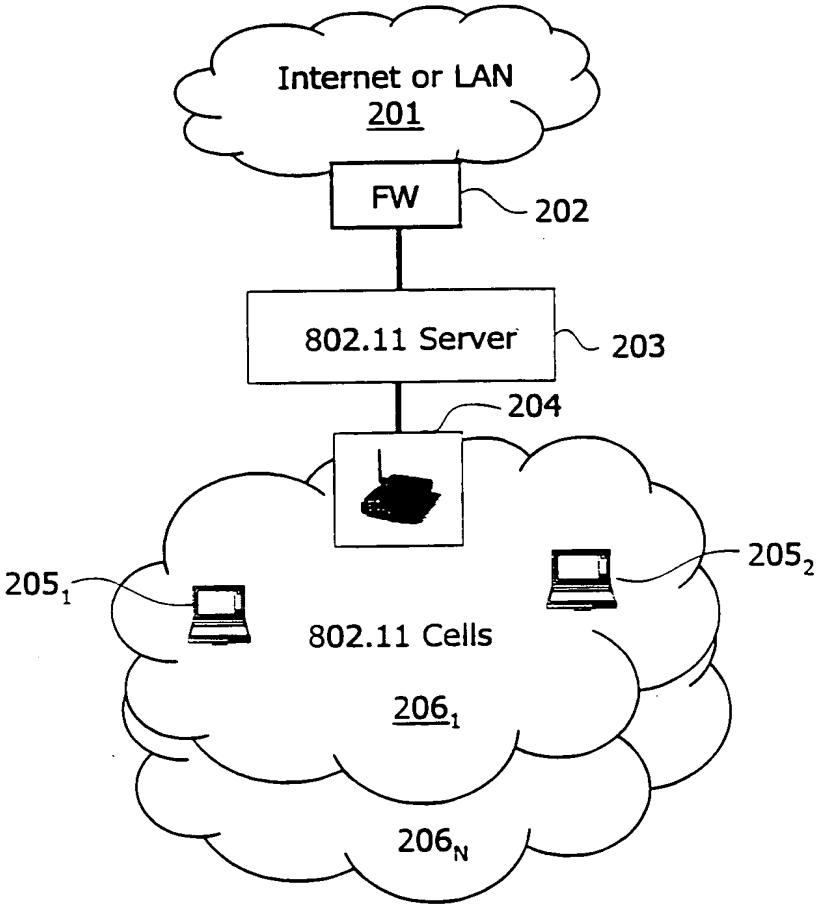

Internet or LAN
201
FW
202
802.11 Server
203
204
205$_1$
205$_2$
802.11 Cells
206$_1$
206$_N$

FIG. 2

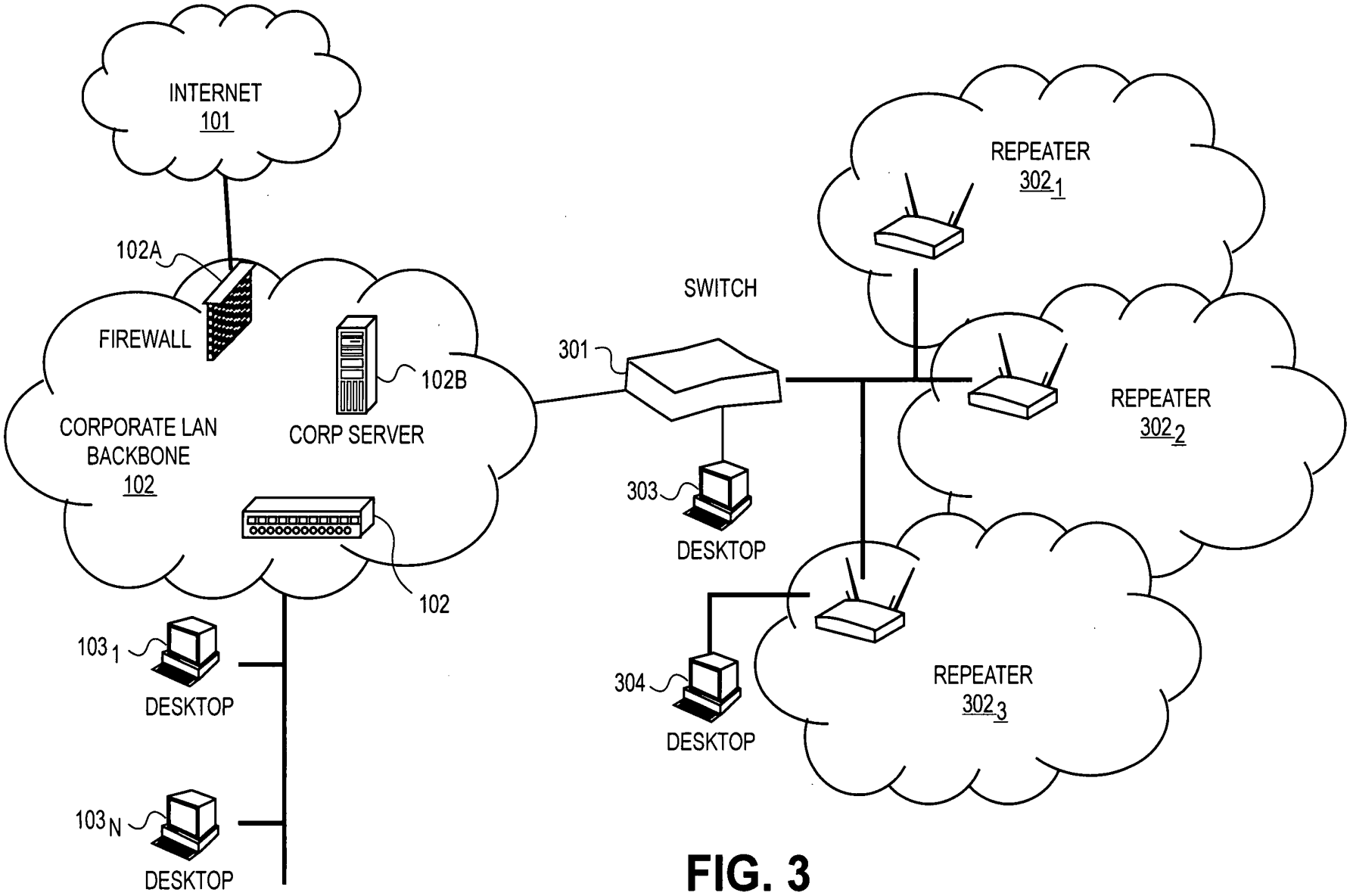

INTERNET
101
102A
FIREWALL
CORPORATE LAN
BACKBONE
102
CORP SERVER
102B
102
103 1
DESKTOP
103 N
DESKTOP
SWITCH
301
303
DESKTOP
304
DESKTOP
REPEATER
302 1
REPEATER
302 2
REPEATER
302 3

FIG. 3

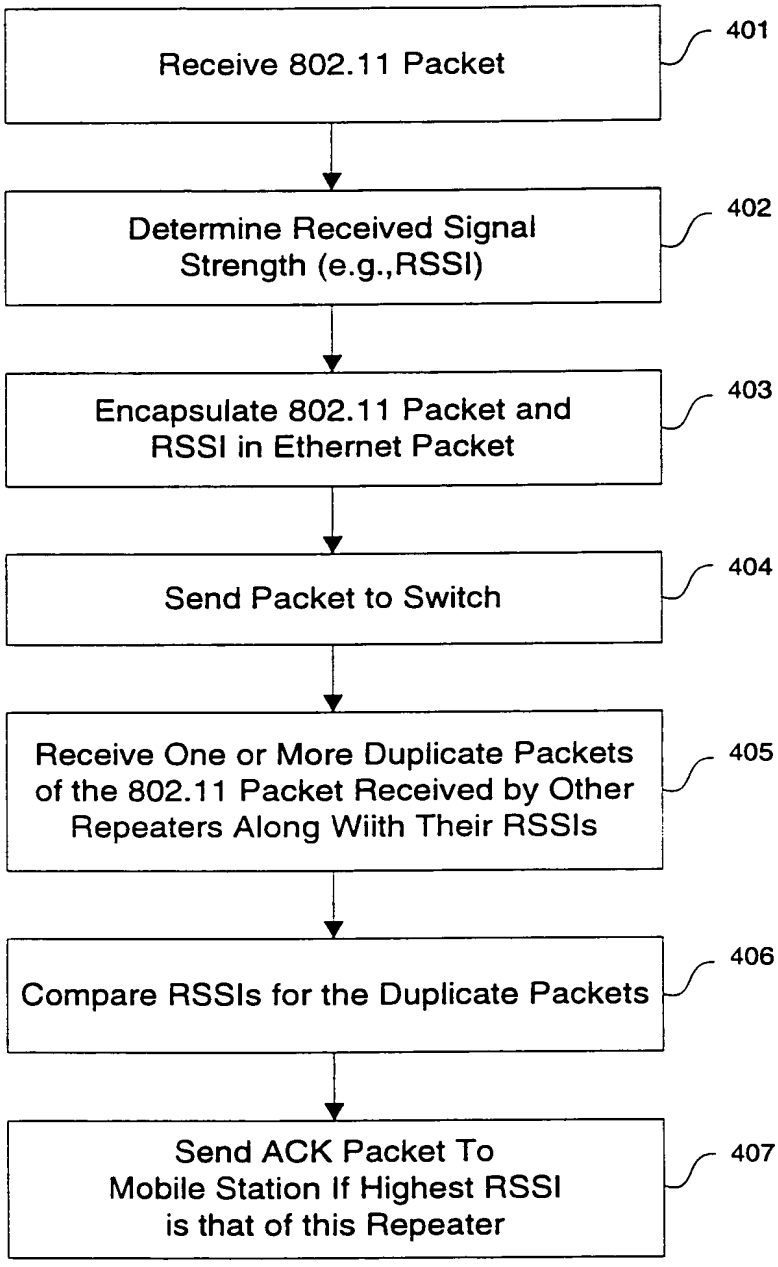

Receive 802.11 Packet
401
Determine Received Signal Strength (e.g.,RSSI)
402
Encapsulate 802.11 Packet and RSSI in Ethernet Packet
403
Send Packet to Switch
404
Receive One or More Duplicate Packets of the 802.11 Packet Received by Other Repeaters Along Wiith Their RSSIs
405
Compare RSSIs for the Duplicate Packets
406
Send ACK Packet To Mobile Station If Highest RSSI is that of this Repeater
407

FIG. 4A

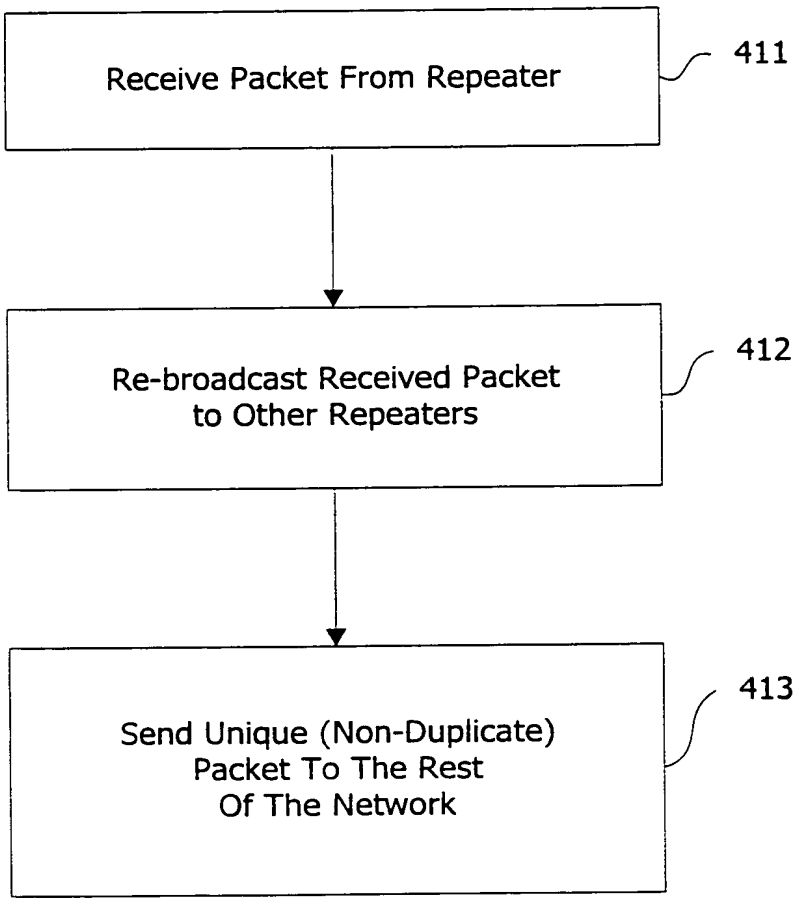

Receive Packet From Repeater
411
Re-broadcast Received Packet to Other Repeaters
412
Send Unique (Non-Duplicate) Packet To The Rest Of The Network
413

FIG. 4B

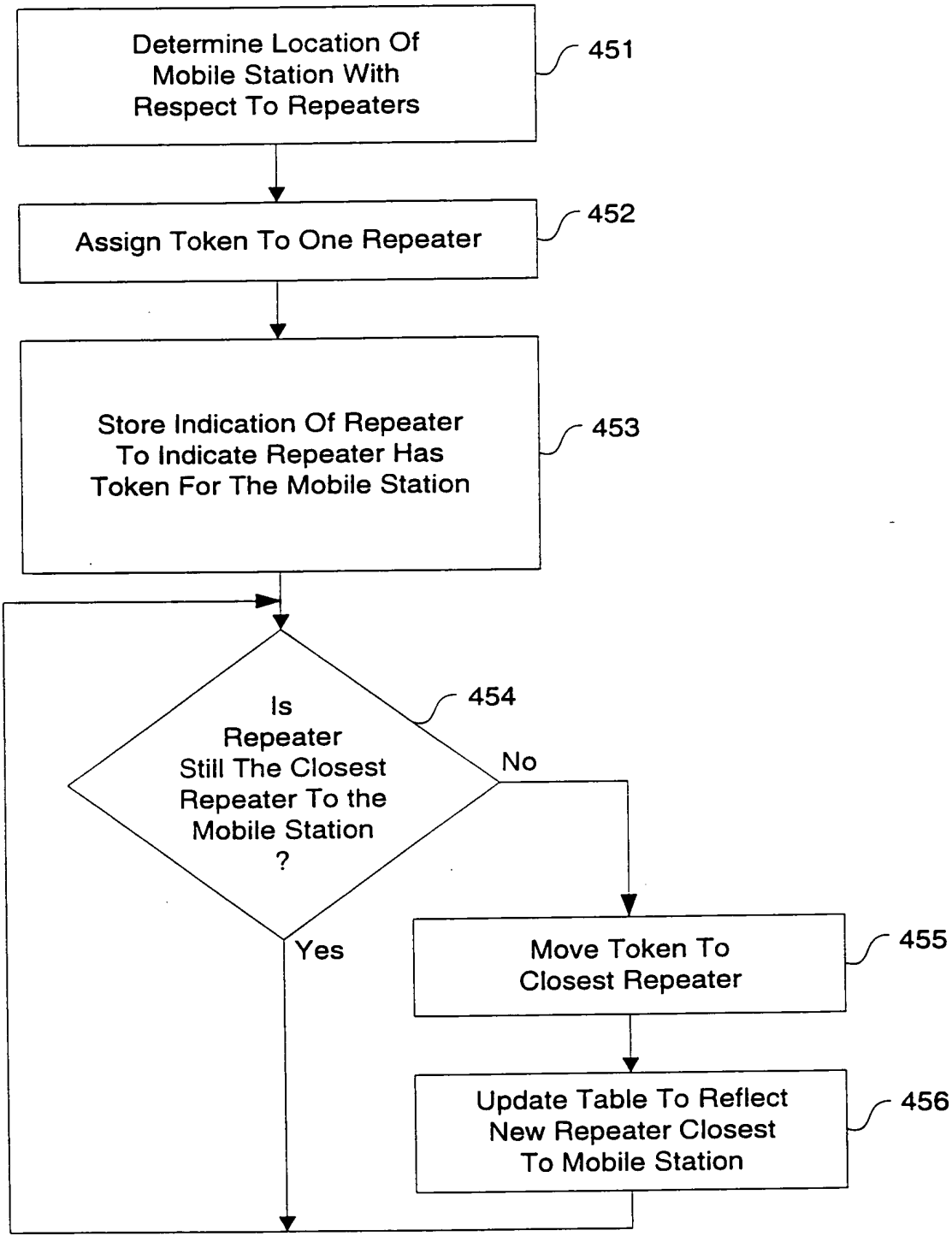

Determine Location Of Mobile Station With Respect To Repeaters
451
Assign Token To One Repeater
452
Store Indication Of Repeater To Indicate Repeater Has Token For The Mobile Station
453
Is Repeater Still The Closest Repeater To the Mobile Station ?
454
No
Yes
Move Token To Closest Repeater
455
Update Table To Reflect New Repeater Closest To Mobile Station
456

FIG. 4C

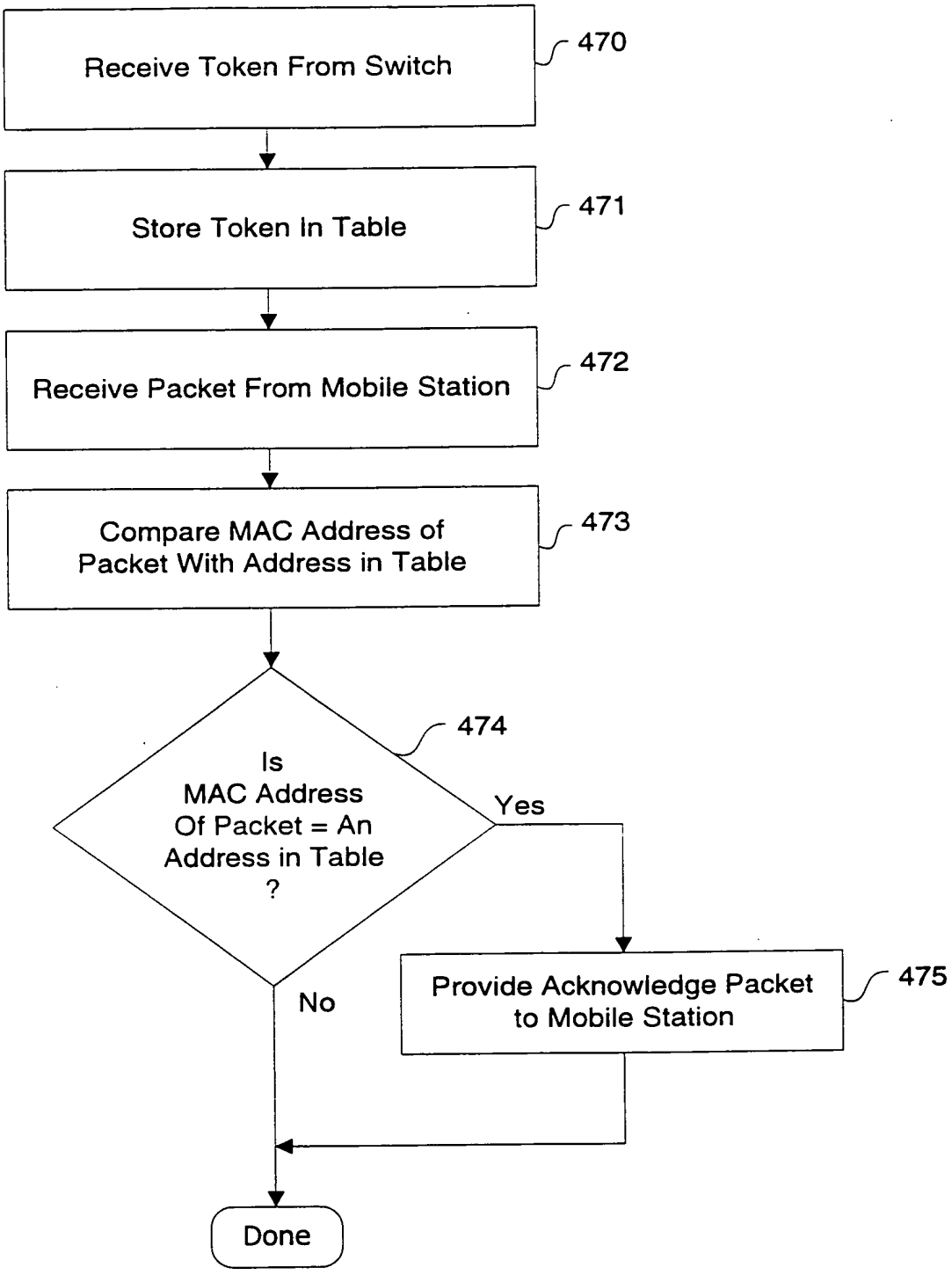

Receive Token From Switch
470
Store Token In Table
471
Receive Packet From Mobile Station
472
Compare MAC Address of Packet With Address in Table
473
Is MAC Address Of Packet = An Address in Table ?
474
Yes
No
Provide Acknowledge Packet to Mobile Station
475
Done

FIG. 4D

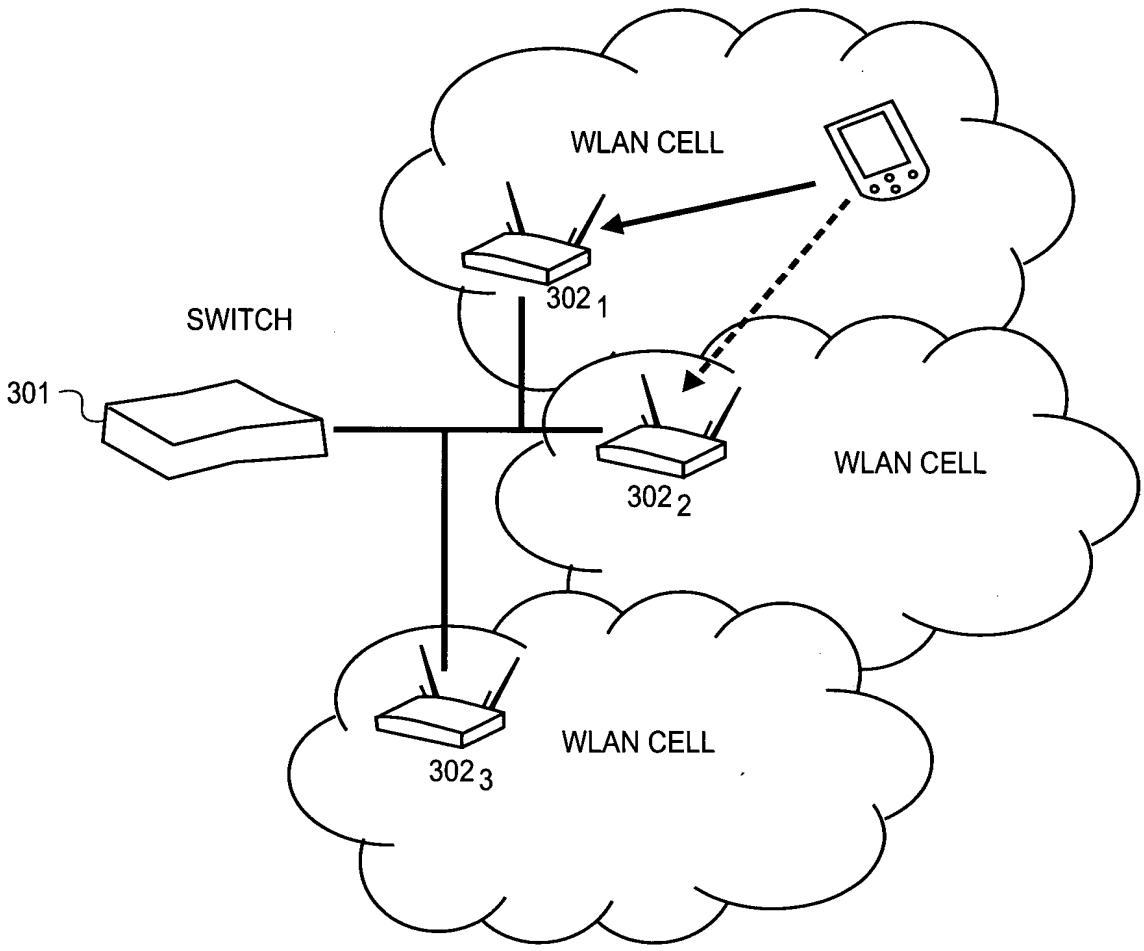


FIG. 5A

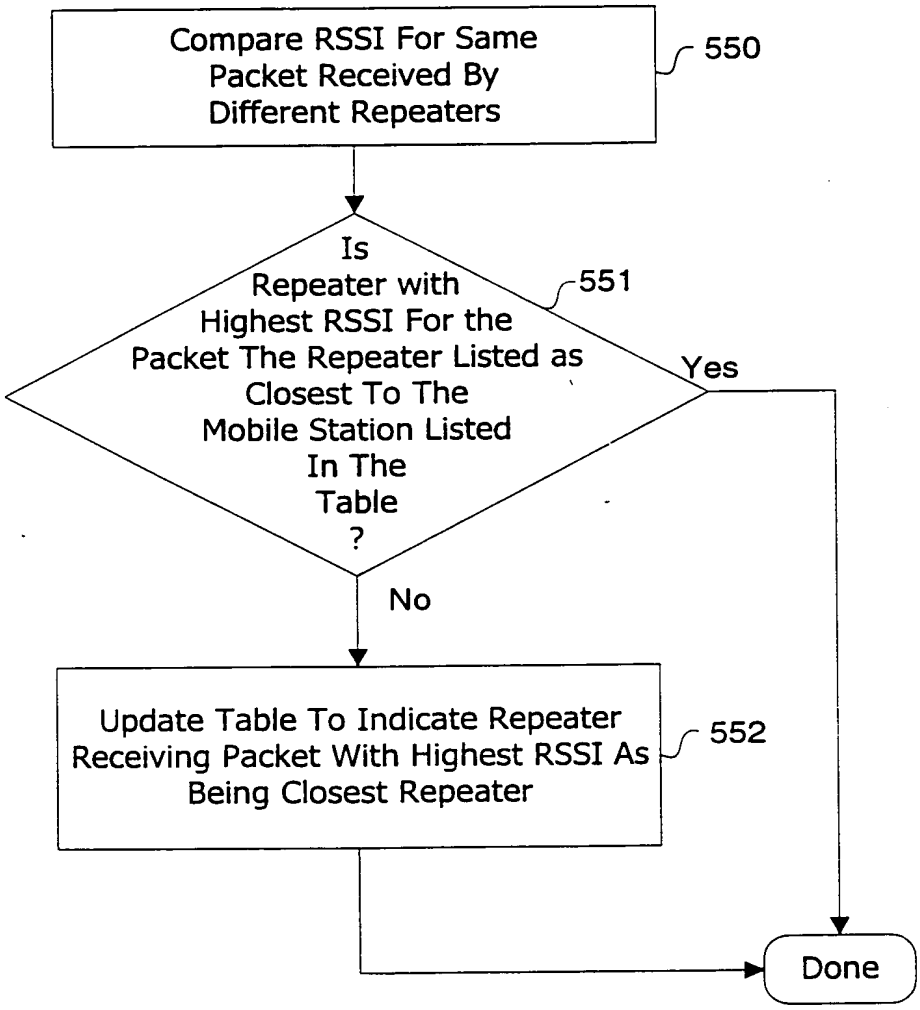

Compare RSSI For Same Packet Received By Different Repeaters
550
Is Repeater with Highest RSSI For the Packet The Repeater Listed as Closest To The Mobile Station Listed In The Table ?
551
Yes
No
Update Table To Indicate Repeater Receiving Packet With Highest RSSI As Being Closest Repeater
552
Done

FIG. 5B

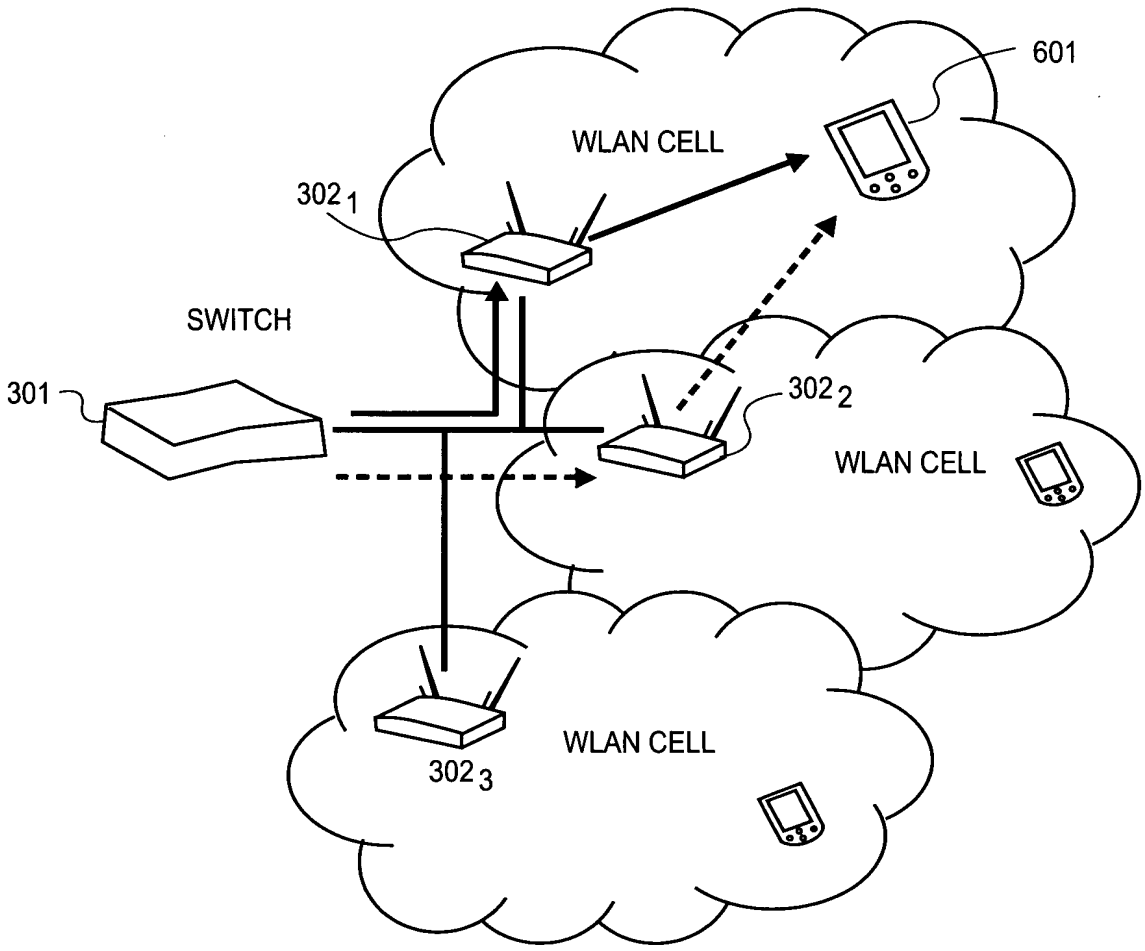


FIG. 6

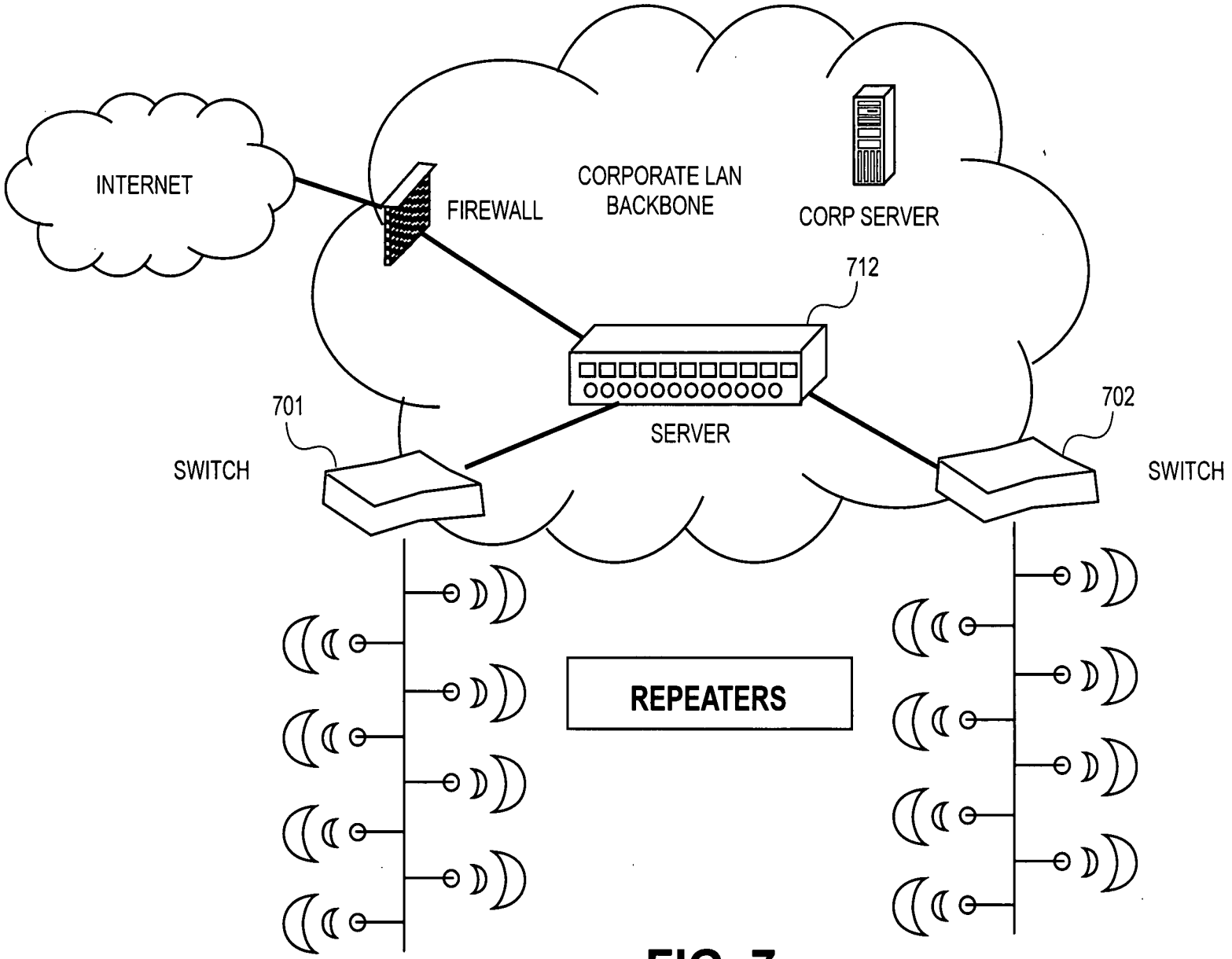

INTERNET
FIREWALL
CORPORATE LAN
BACKBONE
CORP SERVER
712
SERVER
701
SWITCH
702
SWITCH
REPEATERS

FIG. 7

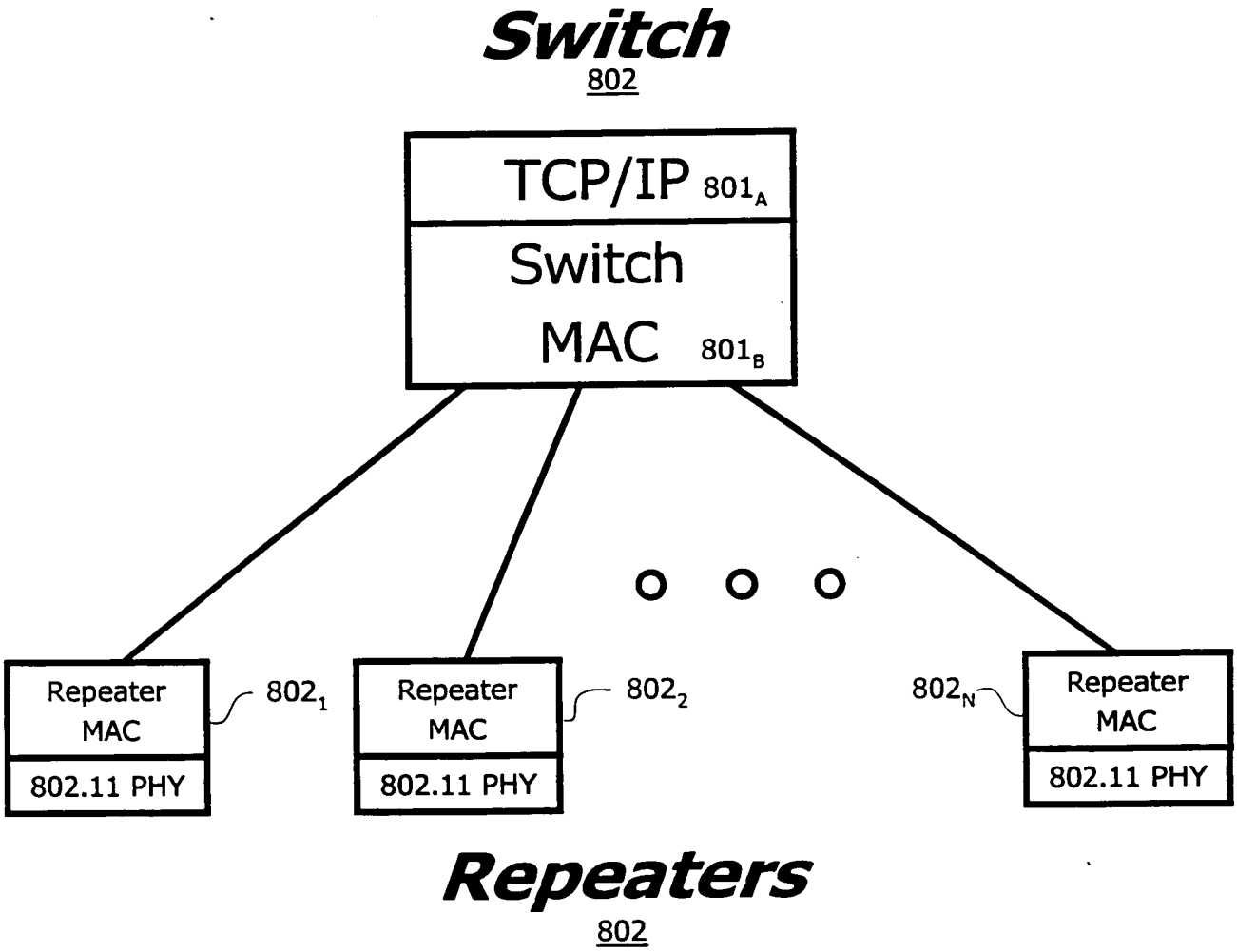

Switch
802
TCP/IP 801A
Switch
MAC 801B
Repeater
MAC
802.11 PHY
802.1
Repeater
MAC
802.11 PHY
802.2
802N
Repeater
MAC
802.11 PHY
Repeaters
802

FIG. 8

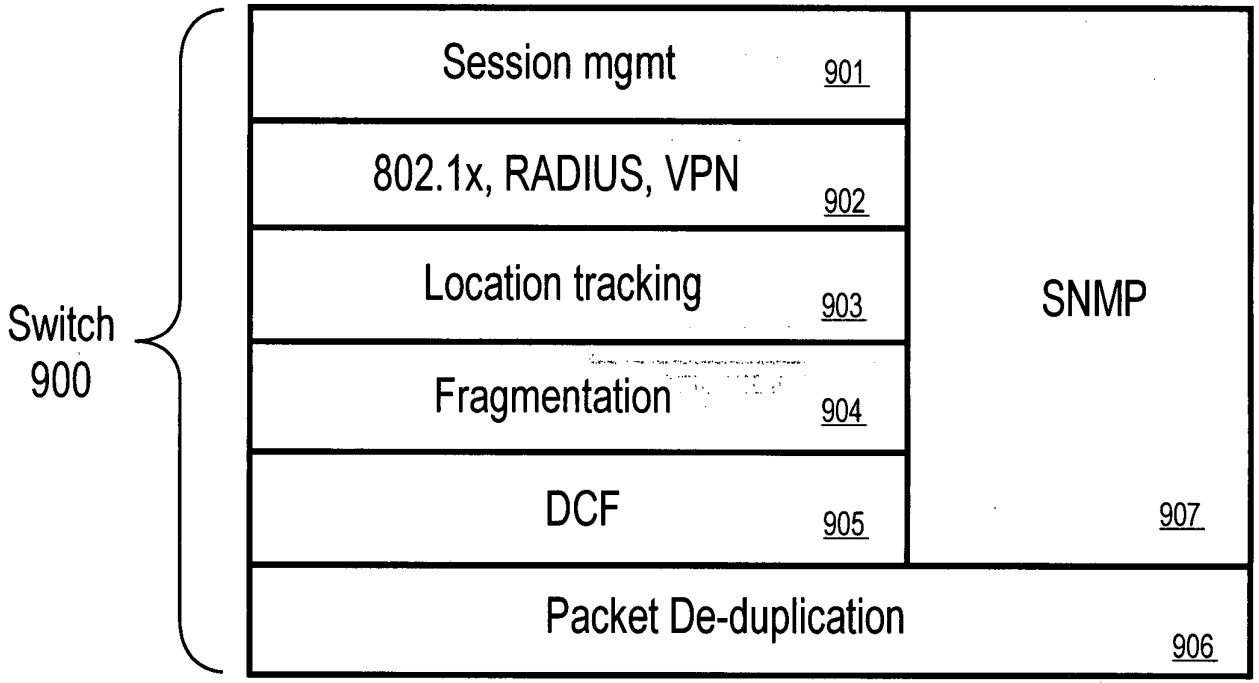

Switch
900
Session mgmt
901
802.1x, RADIUS, VPN
902
Location tracking
903
Fragmentation
904
DCF
905
SNMP
907
Packet De-duplication
906

FIG. 9A

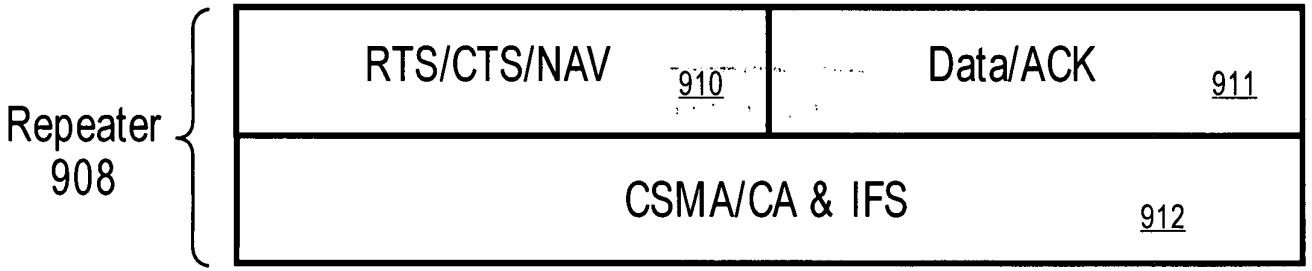


FIG. 9B

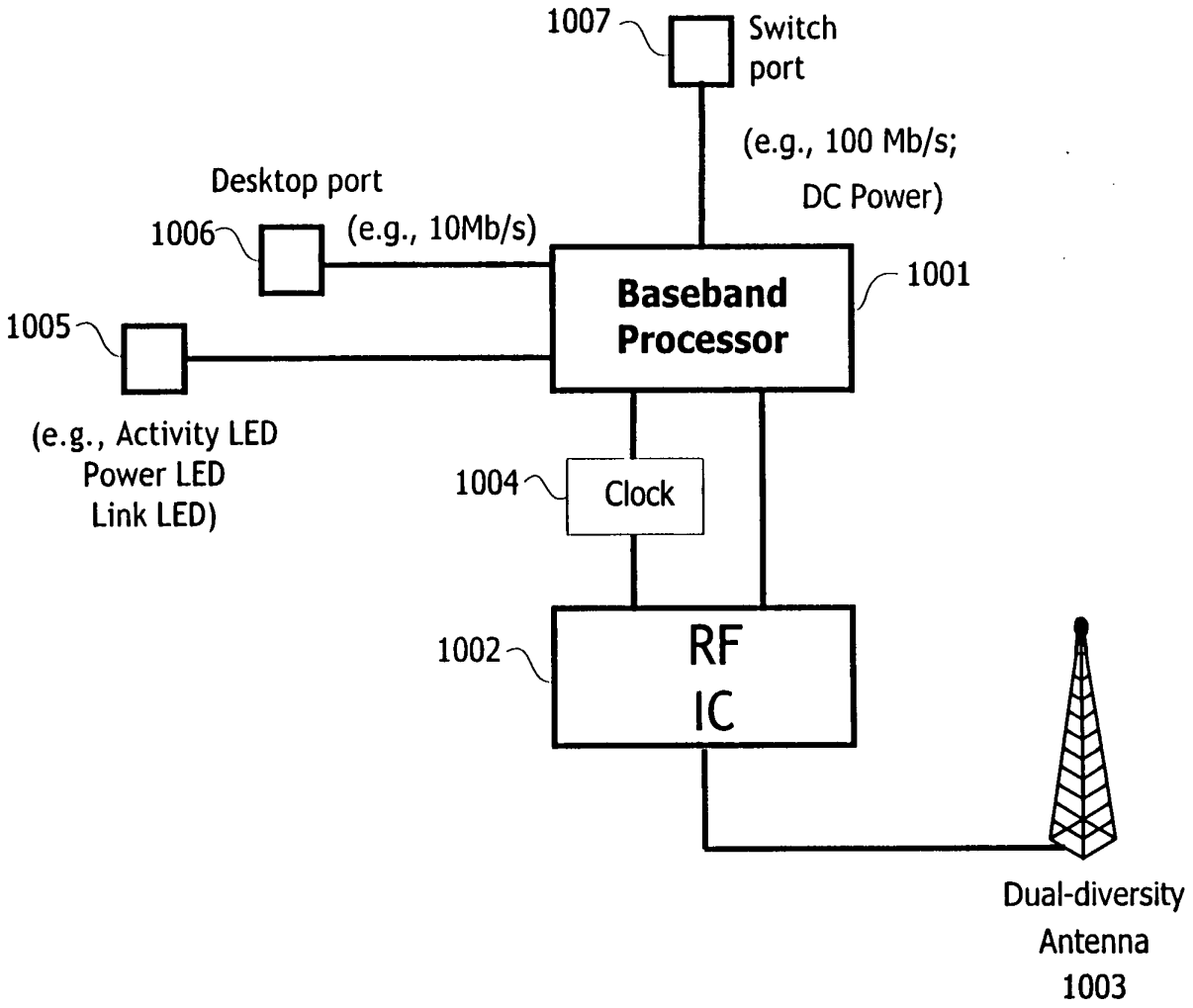

1007
Switch port
(e.g., 100 Mb/s; DC Power)
Desktop port
1006
(e.g., 10Mb/s)
Baseband Processor
1001
1005
(e.g., Activity LED
Power LED
Link LED)
1004
Clock
1002
RF IC
Dual-diversity Antenna 1003

FIG. 10

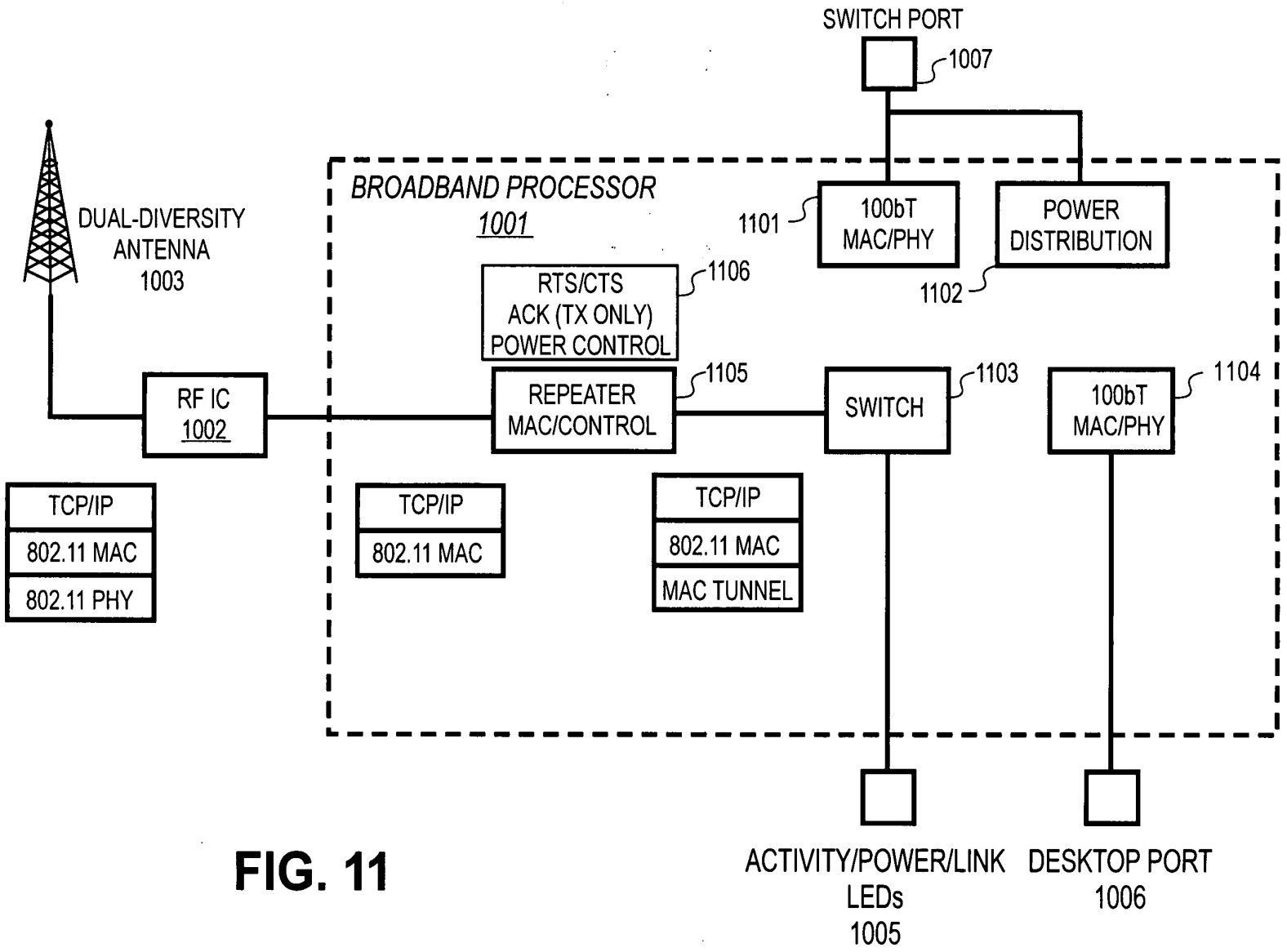

SWITCH PORT
1007
BROADBAND PROCESSOR
1001
1101
100bT
MAC/PHY
POWER
DISTRIBUTION
1102
DUAL-DIVERSITY
ANTENNA
1003
RTS/CTS
ACK (TX ONLY)
POWER CONTROL
1106
RF IC
1002
REPEATER
MAC/CONTROL
1105
SWITCH
1103
100bT
MAC/PHY
1104
TCP/IP
802.11 MAC
802.11 PHY
TCP/IP
802.11 MAC
TCP/IP
802.11 MAC
MAC TUNNEL
ACTIVITY/POWER/LINK
LEDs
1005
DESKTOP PORT
1006

FIG. 11

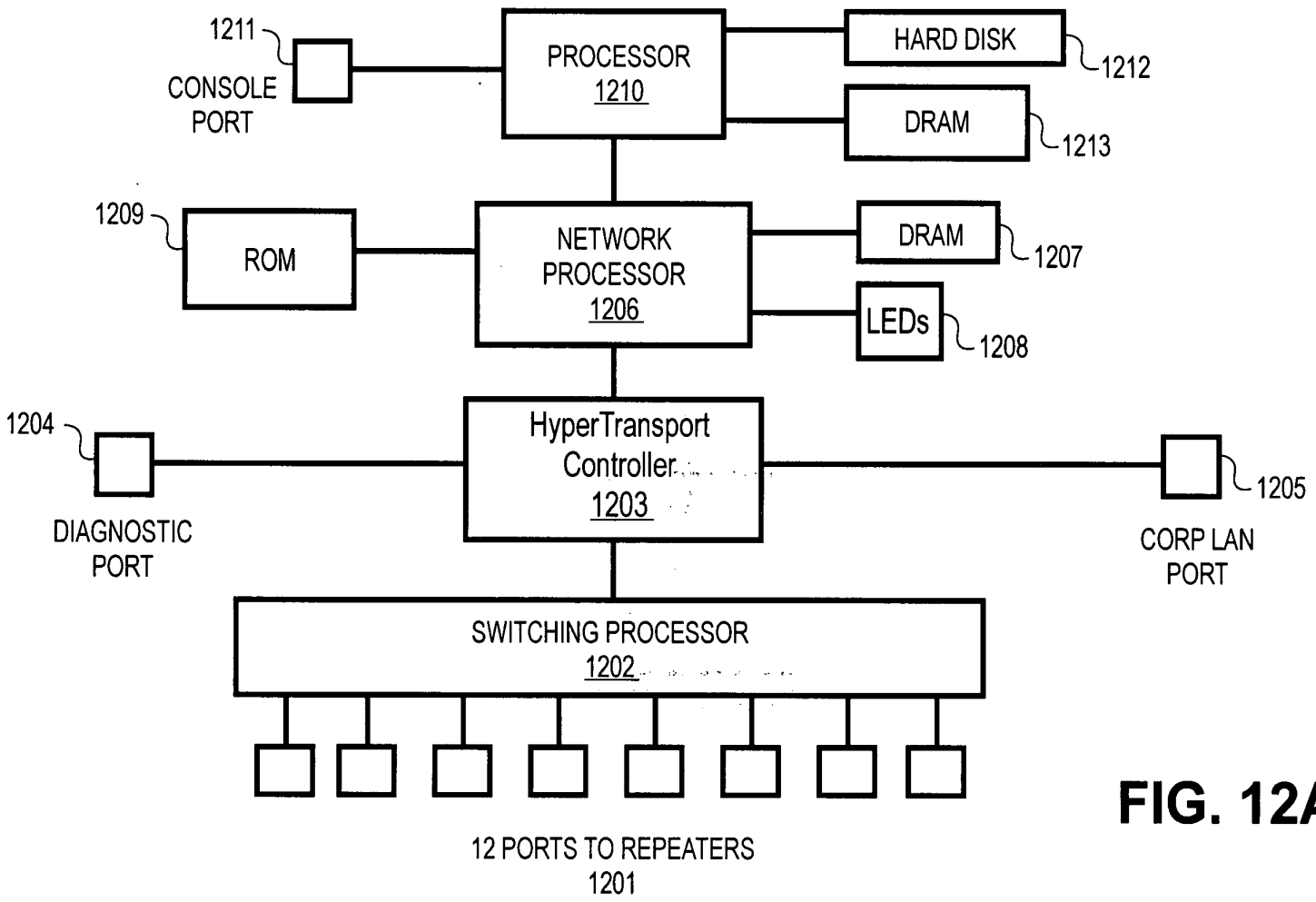

1211
CONSOLE PORT
PROCESSOR 1210
HARD DISK
1212
DRAM
1213
1209
ROM
NETWORK PROCESSOR 1206
DRAM
1207
LEDs
1208
1204
DIAGNOSTIC PORT
HyperTransport Controller 1203
1205
CORP LAN PORT
SWITCHING PROCESSOR 1202
12 PORTS TO REPEATERS 1201

FIG. 12A

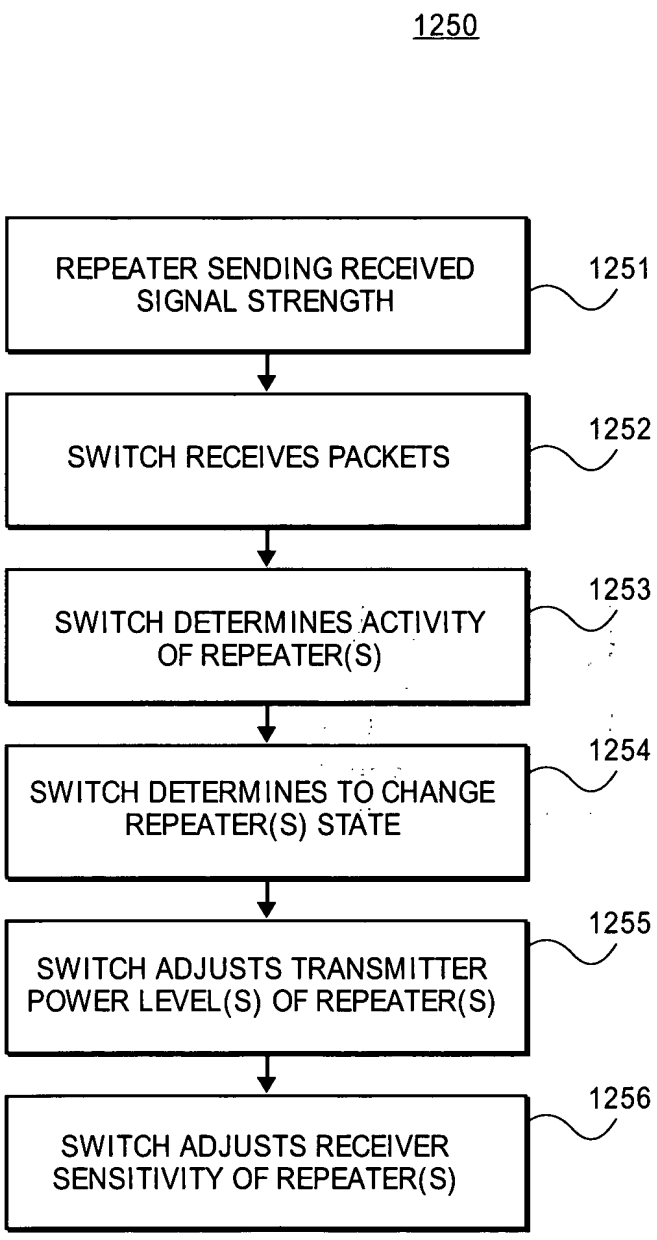

1250
REPEATER SENDING RECEIVED SIGNAL STRENGTH
1251
SWITCH RECEIVES PACKETS
1252
SWITCH DETERMINES ACTIVITY OF REPEATER(S)
1253
SWITCH DETERMINES TO CHANGE REPEATER(S) STATE
1254
SWITCH ADJUSTS TRANSMITTER POWER LEVEL(S) OF REPEATER(S)
1255
SWITCH ADJUSTS RECEIVER SENSITIVITY OF REPEATER(S)
1256

FIG. 12B

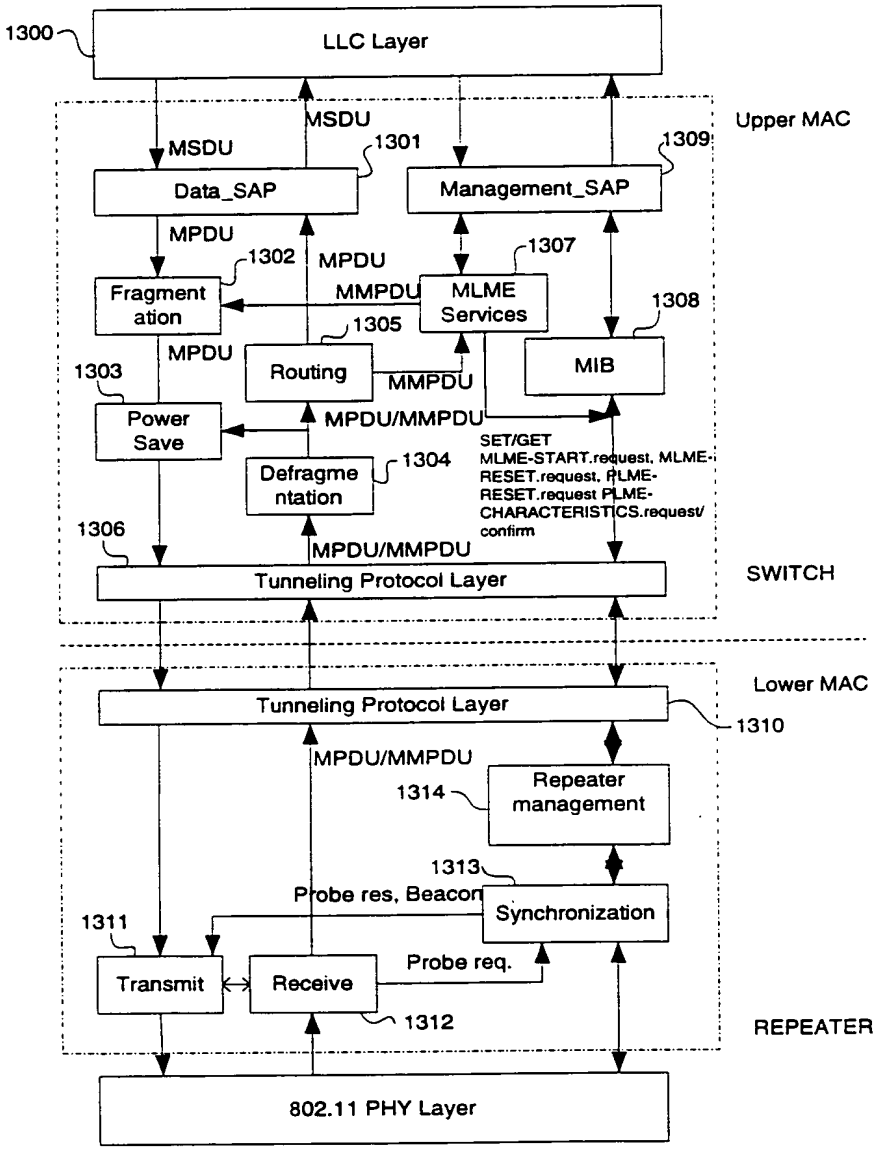

1300
LLC Layer
Upper MAC
MSDU
MSDU
1301
1309
Data_SAP
Management_SAP
MPDU
1302
MPDU
1307
Fragment ation
MMPDU
MLME Services
1308
1305
MPDU
Routing
MMPDU
MIB
1303
Power Save
MPDU/MMPDU
SET/GET MLME-START.request, MLME-RESET.request, PLME-RESET.request PLME-CHARACTERISTICS.request/ confirm
1304
Defragme ntation
1306
MPDU/MMPDU
Tunneling Protocol Layer
SWITCH
Lower MAC
Tunneling Protocol Layer
1310
MPDU/MMPDU
1314
Repeater management
1313
Probe res, Beacon
Synchronization
1311
Probe req.
Transmit
Receive
1312
REPEATER
802.11 PHY Layer

FIG. 13

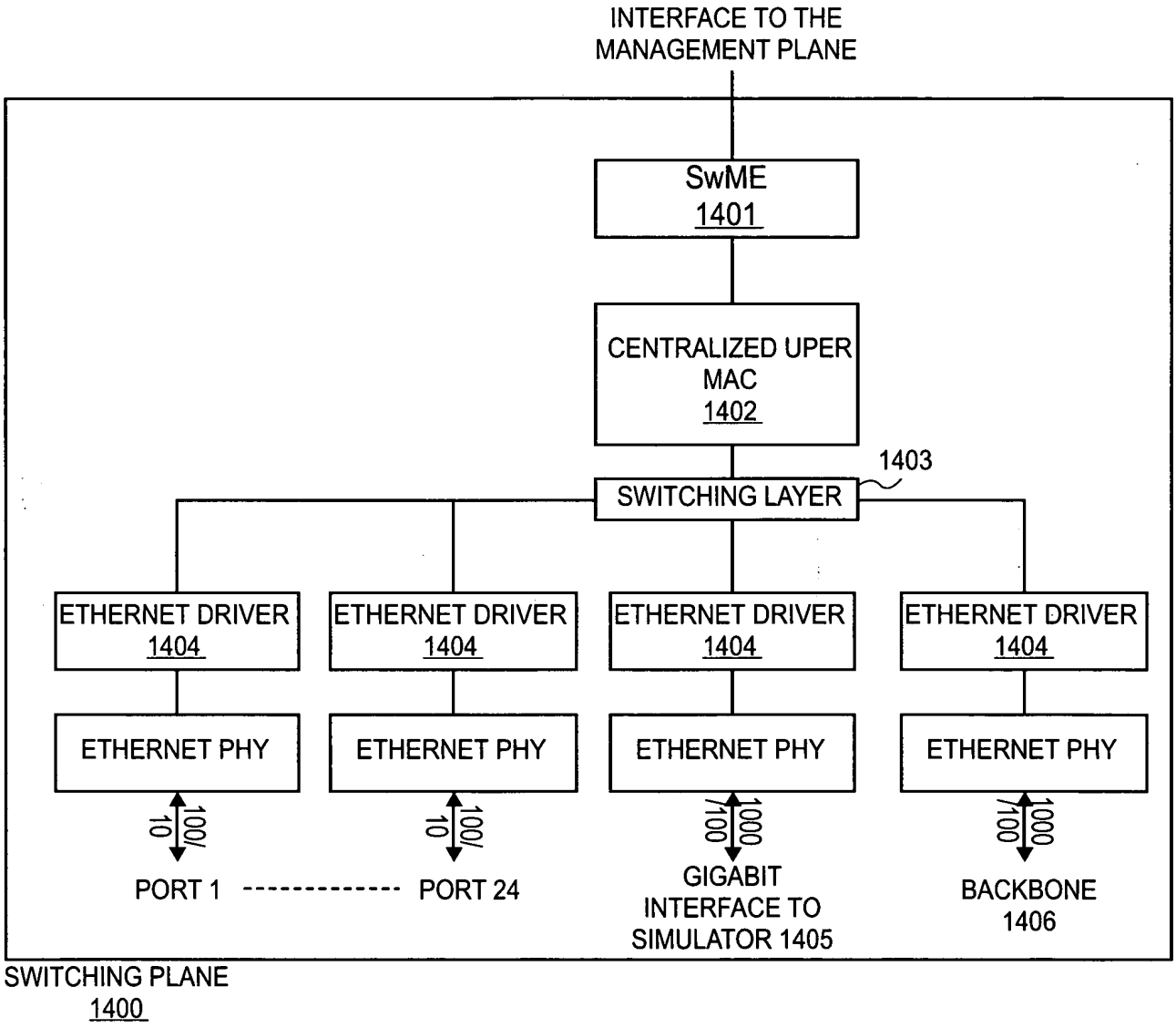

INTERFACE TO THE MANAGEMENT PLANE
SwME 1401
CENTRALIZED UPER MAC 1402
1403
SWITCHING LAYER
ETHERNET DRIVER 1404
ETHERNET DRIVER 1404
ETHERNET DRIVER 1404
ETHERNET DRIVER 1404
ETHERNET PHY
ETHERNET PHY
ETHERNET PHY
ETHERNET PHY
100/10
100/10
1000/100
1000/100
PORT 1
PORT 24
GIGABIT INTERFACE TO SIMULATOR 1405
BACKBONE 1406
SWITCHING PLANE 1400

FIG. 14

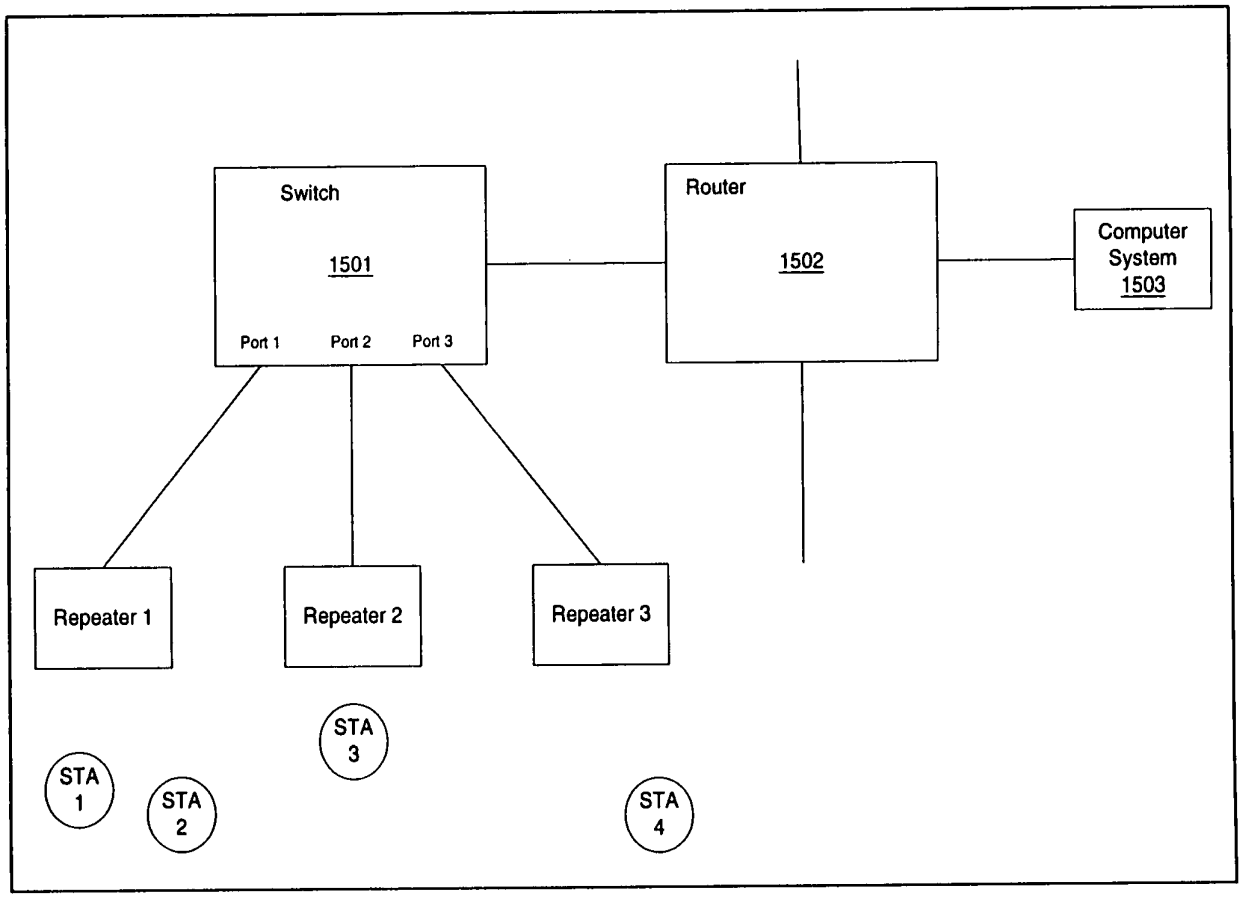

Switch
1501
Port 1
Port 2
Port 3
Router
1502
Computer System
1503
Repeater 1
Repeater 2
Repeater 3
STA 1
STA 2
STA 3
STA 4

FIG. 15

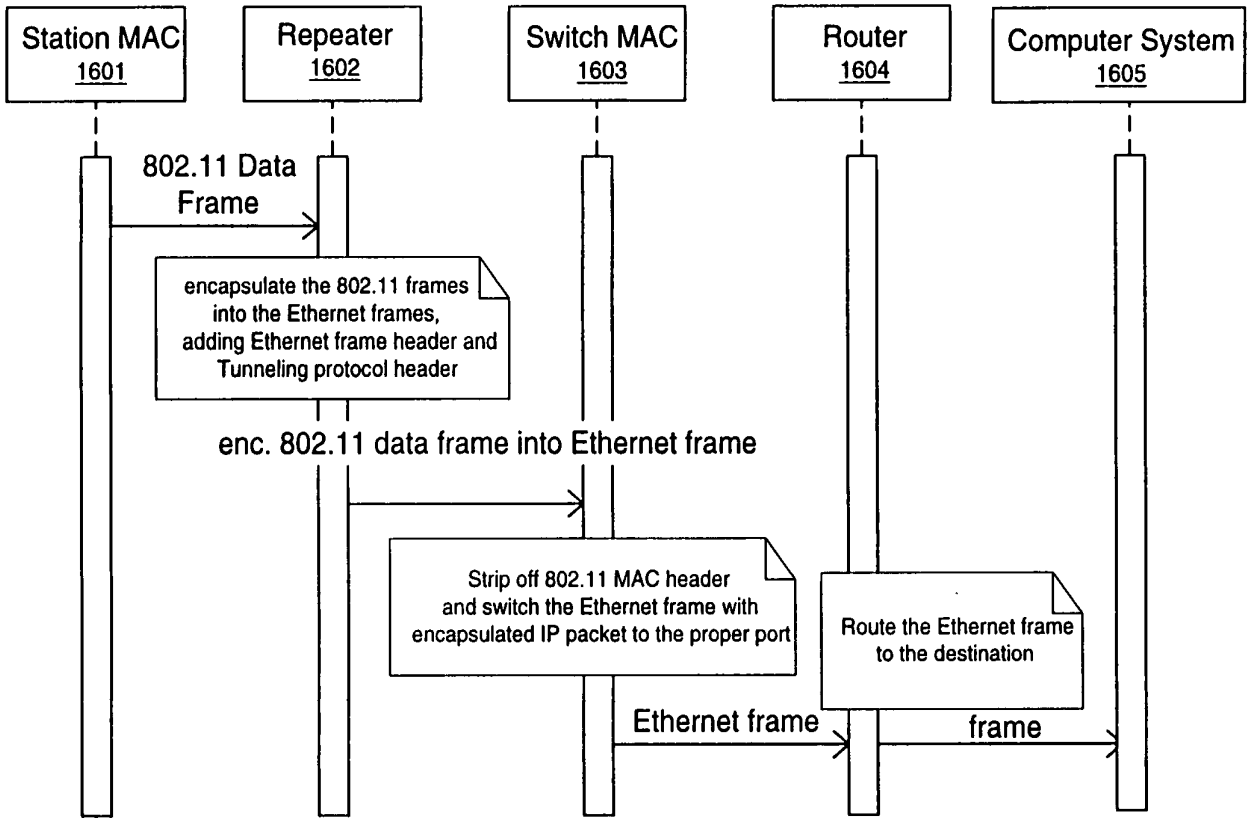

Station MAC
1601
Repeater
1602
Switch MAC
1603
Router
1604
Computer System
1605
802.11 Data Frame
encapsulate the 802.11 frames into the Ethernet frames, adding Ethernet frame header and Tunneling protocol header
enc. 802.11 data frame into Ethernet frame
Strip off 802.11 MAC header and switch the Ethernet frame with encapsulated IP packet to the proper port
Route the Ethernet frame to the destination
Ethernet frame
frame

FIG. 16

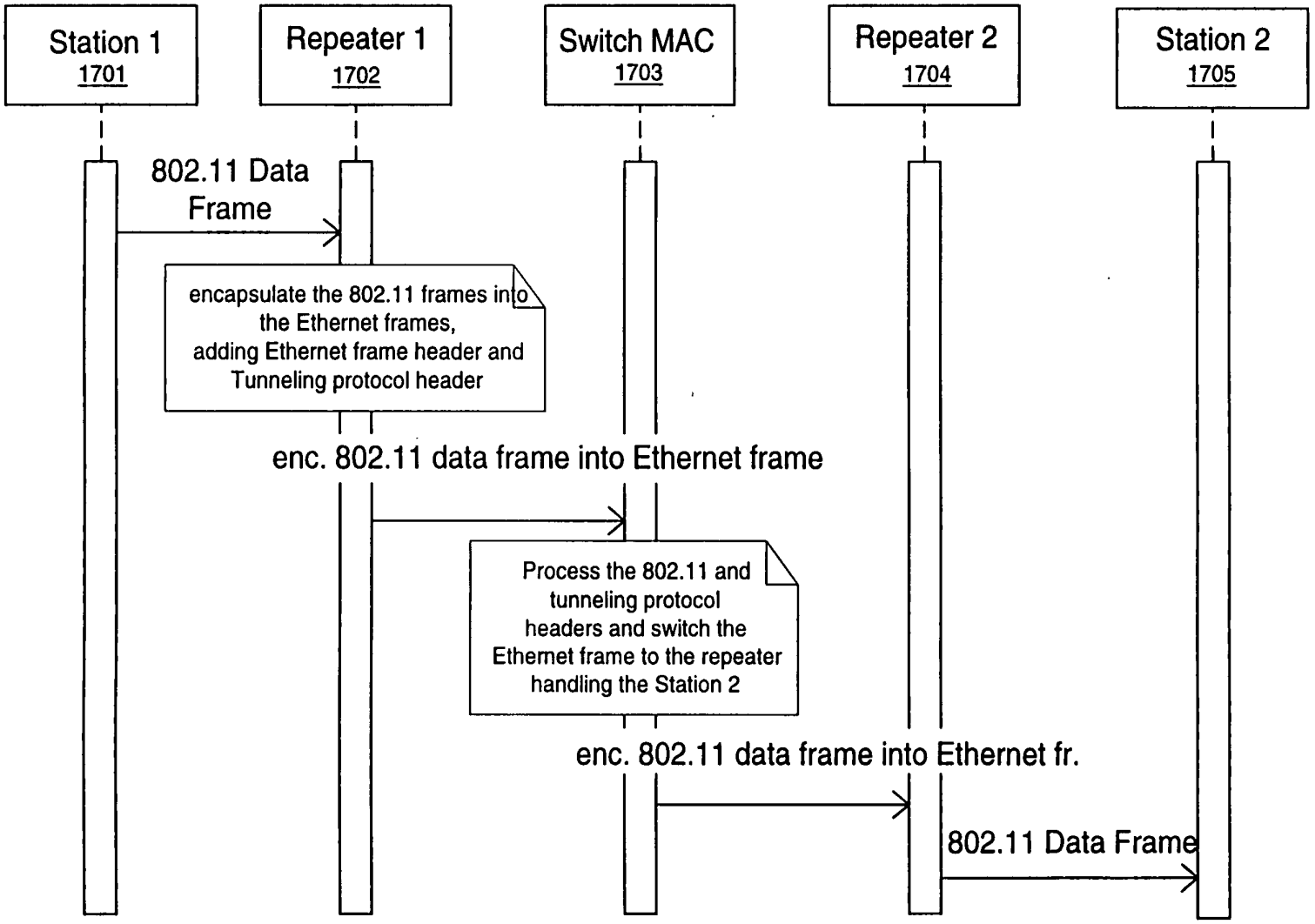

Station 1
1701
Repeater 1
1702
Switch MAC
1703
Repeater 2
1704
Station 2
1705
802.11 Data Frame
encapsulate the 802.11 frames into the Ethernet frames, adding Ethernet frame header and Tunneling protocol header
enc. 802.11 data frame into Ethernet frame
Process the 802.11 and tunneling protocol headers and switch the Ethernet frame to the repeater handling the Station 2
enc. 802.11 data frame into Ethernet fr.
802.11 Data Frame

FIG. 17

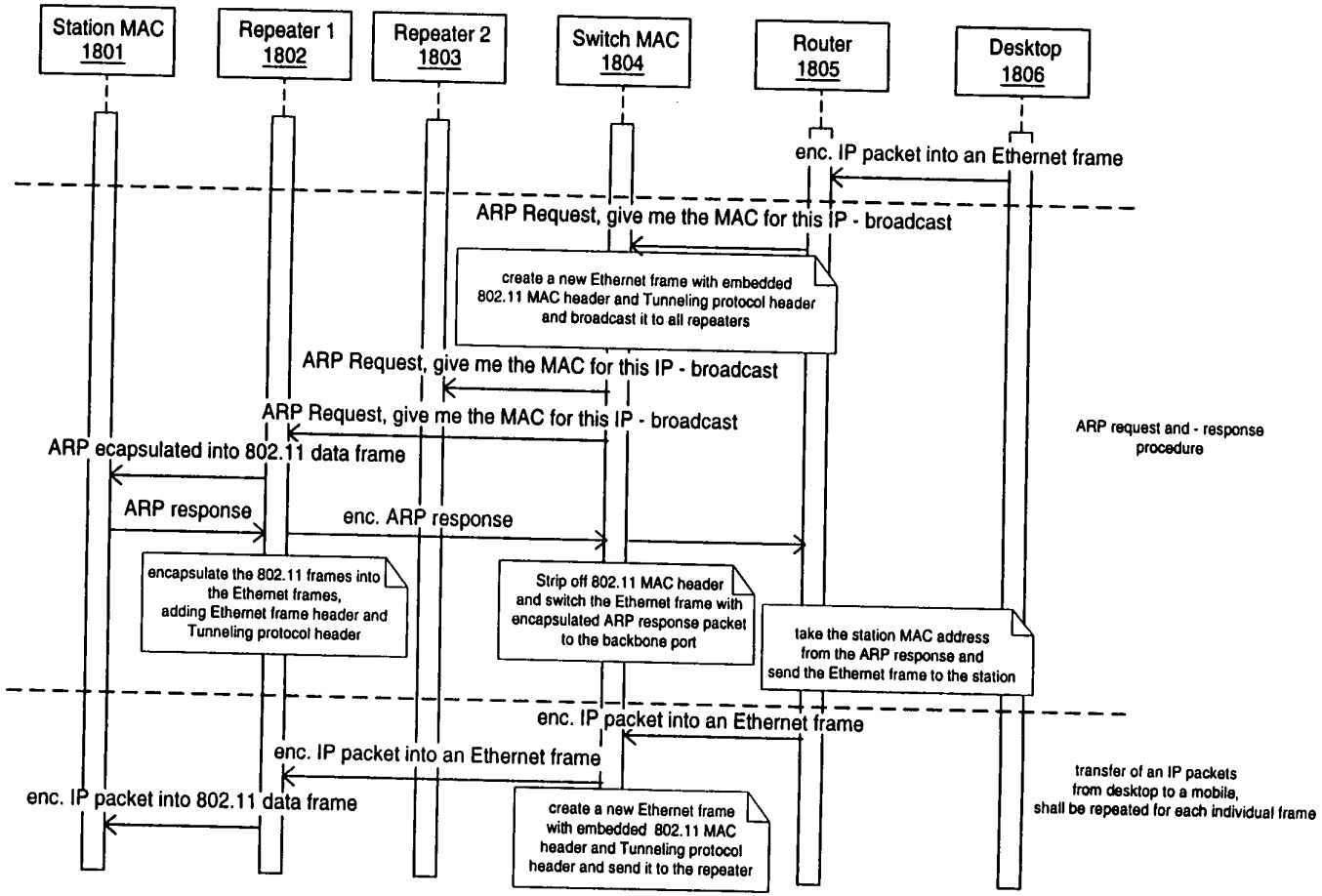

Station MAC
1801
Repeater 1
1802
Repeater 2
1803
Switch MAC
1804
Router
1805
Desktop
1806
enc. IP packet into an Ethernet frame
ARP Request, give me the MAC for this IP - broadcast
create a new Ethernet frame with embedded 802.11 MAC header and Tunneling protocol header and broadcast it to all repeaters
ARP Request, give me the MAC for this IP - broadcast
ARP Request, give me the MAC for this IP - broadcast
ARP ecapsulated into 802.11 data frame
ARP response
enc. ARP response
encapsulate the 802.11 frames into the Ethernet frames, adding Ethernet frame header and Tunneling protocol header
Strip off 802.11 MAC header and switch the Ethernet frame with encapsulated ARP response packet to the backbone port
take the station MAC address from the ARP response and send the Ethernet frame to the station
enc. IP packet into an Ethernet frame
enc. IP packet into an Ethernet frame
enc. IP packet into 802.11 data frame
create a new Ethernet frame with embedded 802.11 MAC header and Tunneling protocol header and send it to the repeater
ARP request and - response procedure
transfer of an IP packets from desktop to a mobile, shall be repeated for each individual frame

FIG. 18

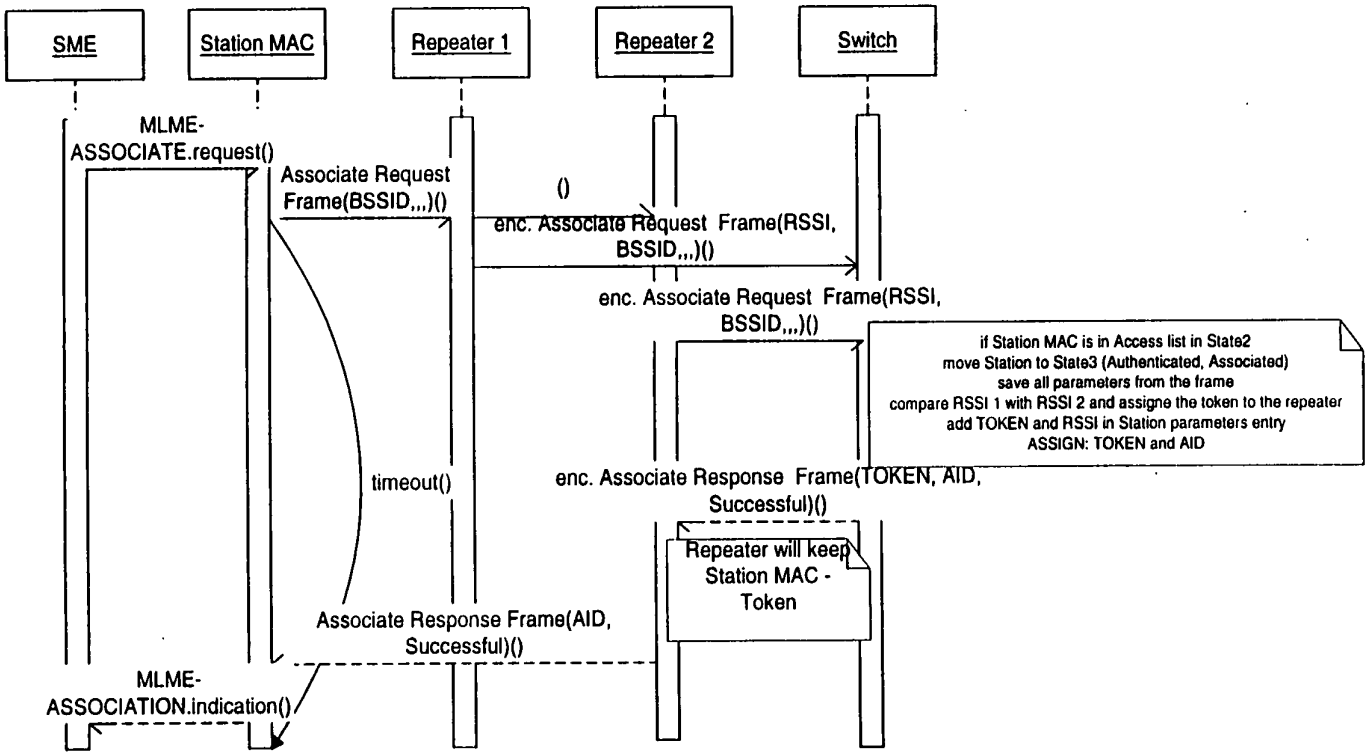

SME
Station MAC
Repeater 1
Repeater 2
Switch
MLME-
ASSOCIATE.request()
Associate Request
Frame(BSSID,,,)()
()
enc. Associate Request Frame(RSSI,
BSSID,,,)()
enc. Associate Request Frame(RSSI,
BSSID,,,)()
if Station MAC is in Access list in State2
move Station to State3 (Authenticated, Associated)
save all parameters from the frame
compare RSSI 1 with RSSI 2 and assigne the token to the repeater
add TOKEN and RSSI in Station parameters entry
ASSIGN: TOKEN and AID
timeout()
enc. Associate Response Frame(TOKEN, AID,
Successful)()
Repeater will keep
Station MAC -
Token
Associate Response Frame(AID,
Successful)()
MLME-
ASSOCIATION.indication()

FIG. 19

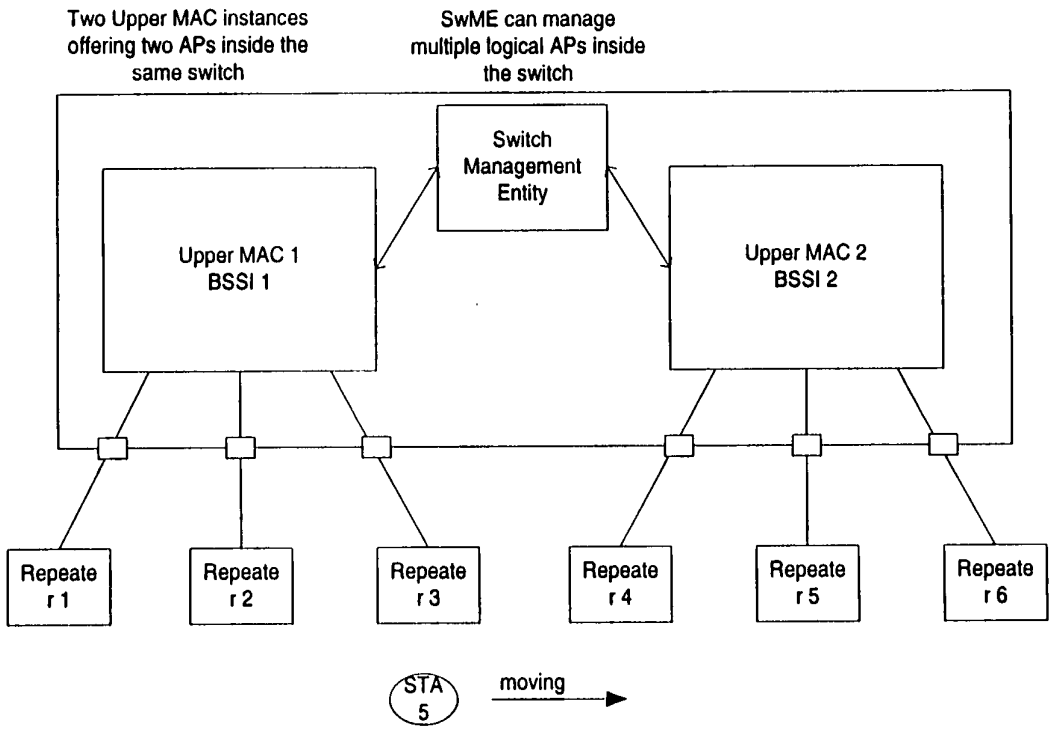

Two Upper MAC instances offering two APs inside the same switch
SwME can manage multiple logical APs inside the switch
Switch Management Entity
Upper MAC 1 BSSI 1
Upper MAC 2 BSSI 2
Repeate r 1
Repeate r 2
Repeate r 3
Repeate r 4
Repeate r 5
Repeate r 6
STA 5
moving

FIG. 20

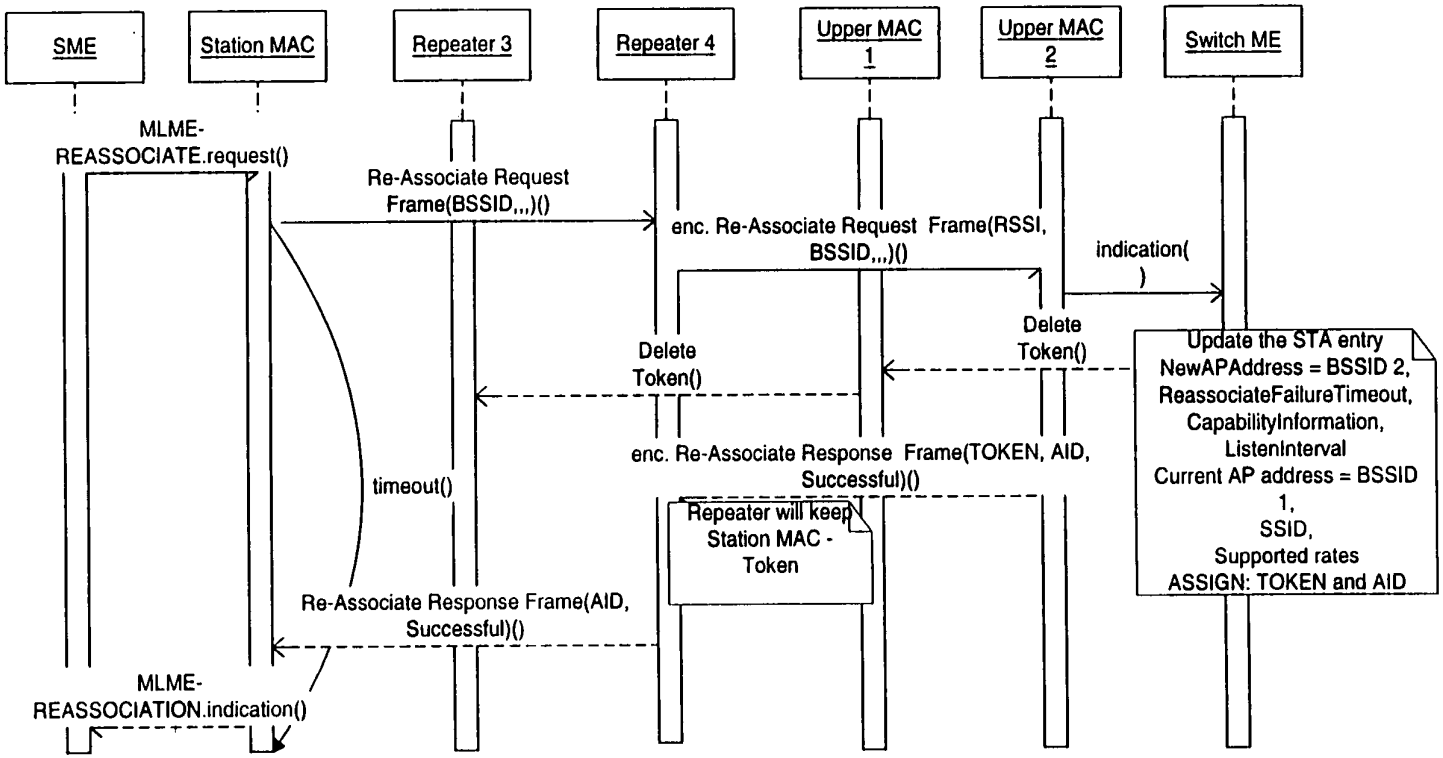

SME
Station MAC
Repeater 3
Repeater 4
Upper MAC 1
Upper MAC 2
Switch ME
MLME-REASSOCIATE.request()
Re-Associate Request Frame(BSSID,,,)()
enc. Re-Associate Request Frame(RSSI, BSSID,,,)()
indication( )
Delete Token()
Delete Token()
Update the STA entry
NewAPAddress = BSSID 2,
ReassociateFailureTimeout,
CapabilityInformation,
ListenInterval
Current AP address = BSSID 1,
SSID,
Supported rates
ASSIGN: TOKEN and AID
timeout()
enc. Re-Associate Response Frame(TOKEN, AID, Successful)()
Repeater will keep Station MAC - Token
Re-Associate Response Frame(AID, Successful)()
MLME-REASSOCIATION.indication()

FIG. 21

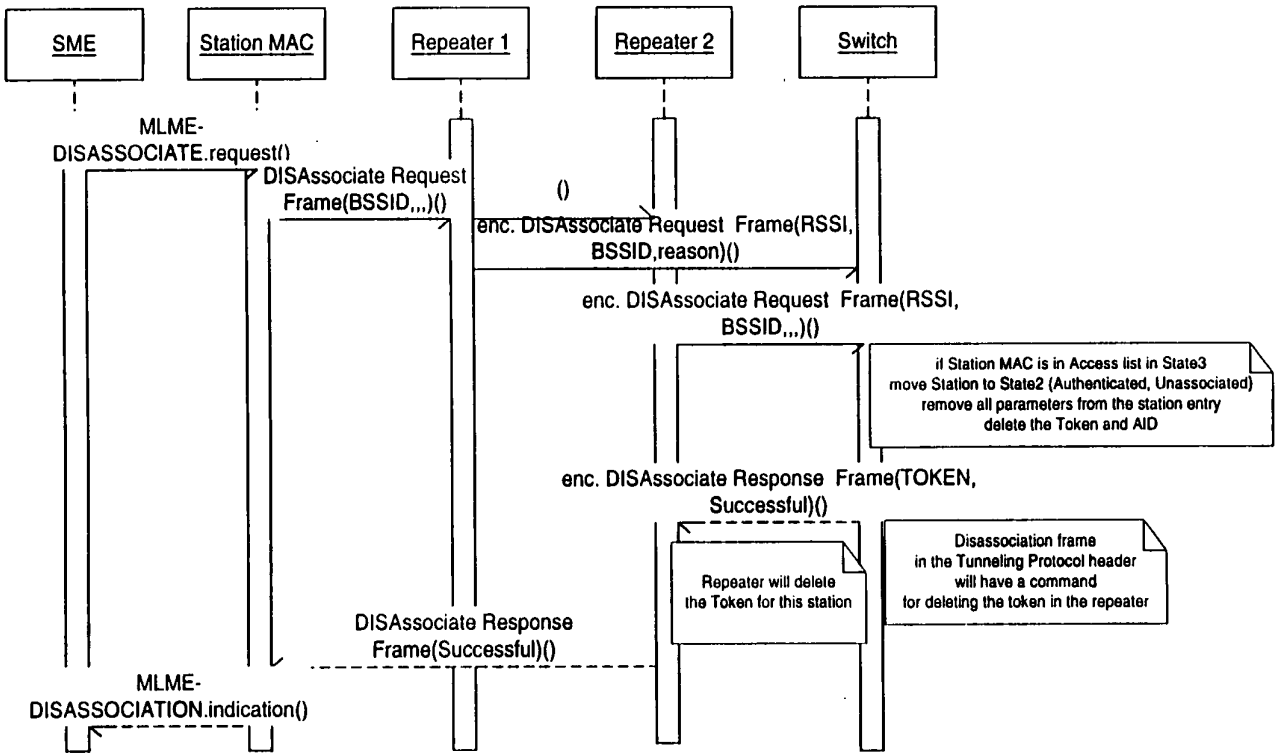

SME
Station MAC
Repeater 1
Repeater 2
Switch
MLME-
DISASSOCIATE.request()
DISAssociate Request
Frame(BSSID,,,)()
()
enc. DISAssociate Request Frame(RSSI,
BSSID,reason)()
enc. DISAssociate Request Frame(RSSI,
BSSID,,,)()
if Station MAC is in Access list in State3
move Station to State2 (Authenticated, Unassociated)
remove all parameters from the station entry
delete the Token and AID
enc. DISAssociate Response Frame(TOKEN,
Successful)()
Repeater will delete
the Token for this station
Disassociation frame
in the Tunneling Protocol header
will have a command
for deleting the token in the repeater
DISAssociate Response
Frame(Successful)()
MLME-
DISASSOCIATION.indication()

FIG. 22

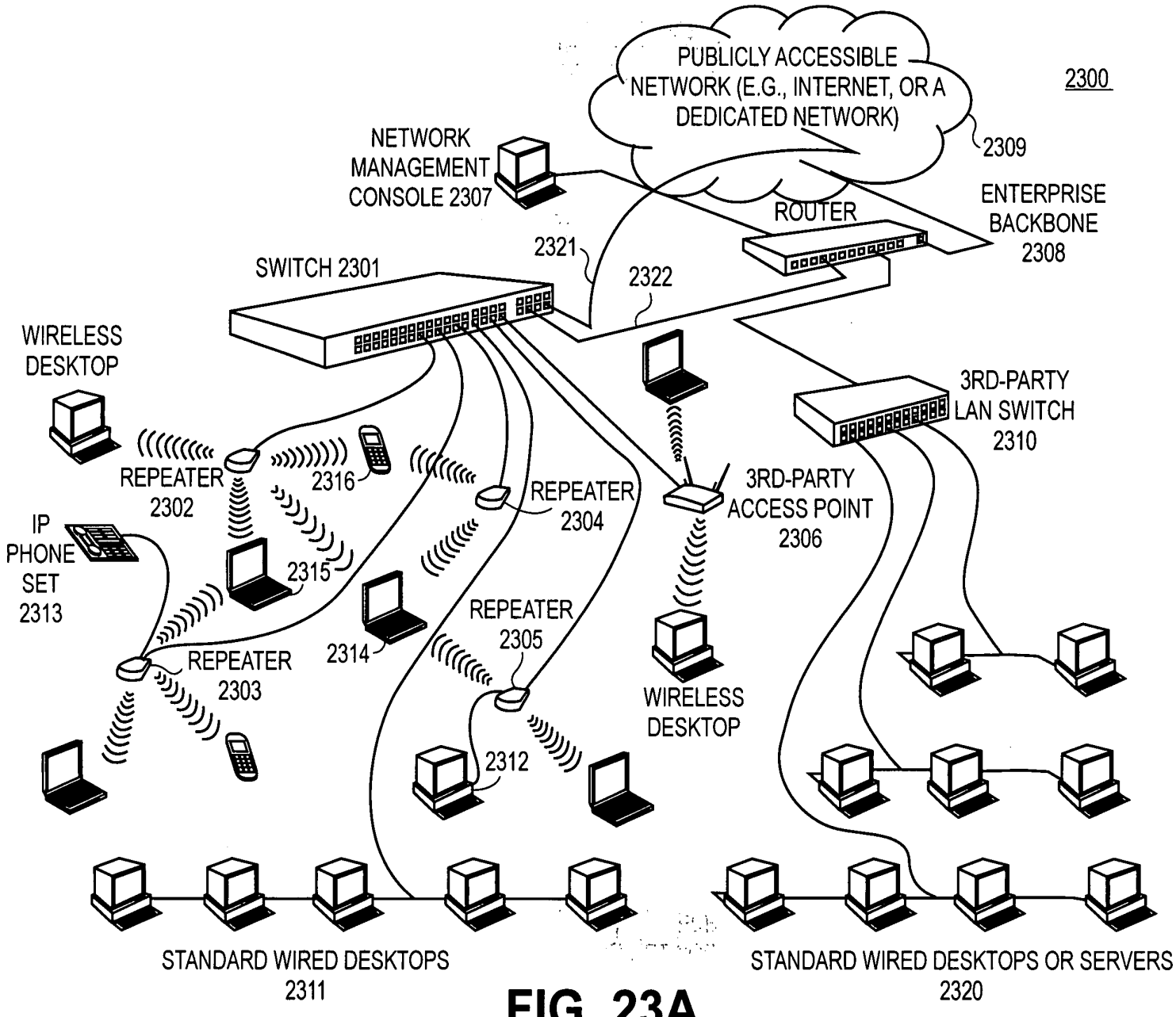

PUBLICLY ACCESSIBLE NETWORK (E.G., INTERNET, OR A DEDICATED NETWORK)
2309
2300
NETWORK MANAGEMENT CONSOLE 2307
ROUTER
ENTERPRISE BACKBONE 2308
2321
2322
SWITCH 2301
WIRELESS DESKTOP
3RD-PARTY LAN SWITCH 2310
REPEATER 2302
2316
REPEATER 2304
3RD-PARTY ACCESS POINT 2306
IP PHONE SET 2313
2315
REPEATER 2305
2314
REPEATER 2303
WIRELESS DESKTOP
2312
STANDARD WIRED DESKTOPS 2311
STANDARD WIRED DESKTOPS OR SERVERS 2320

FIG. 23A

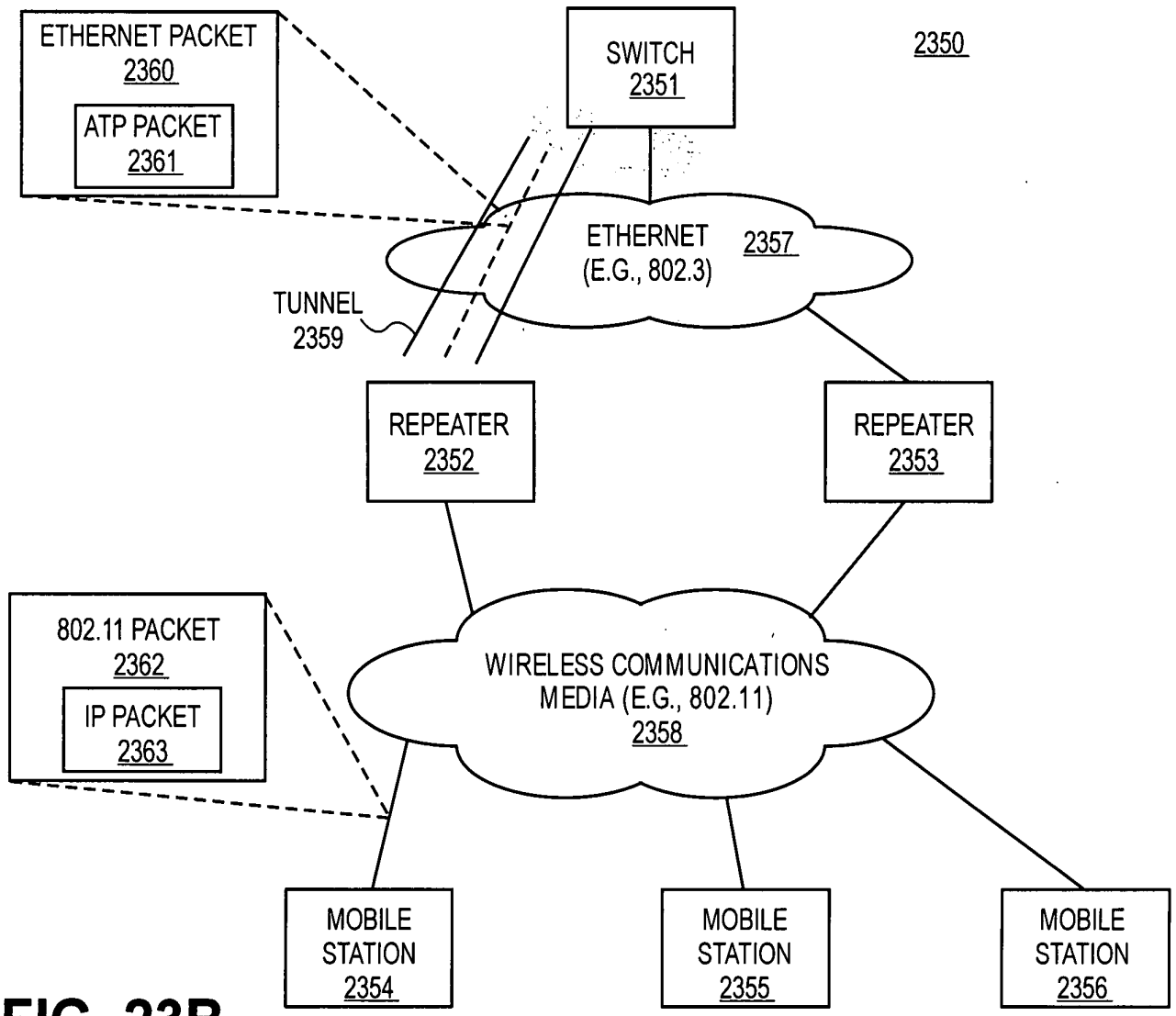

ETHERNET PACKET
2360
ATP PACKET
2361
SWITCH
2351
2350
ETHERNET
(E.G., 802.3)
2357
TUNNEL
2359
REPEATER
2352
REPEATER
2353
802.11 PACKET
2362
IP PACKET
2363
WIRELESS COMMUNICATIONS
MEDIA (E.G., 802.11)
2358
MOBILE
STATION
2354
MOBILE
STATION
2355
MOBILE
STATION
2356

FIG. 23B

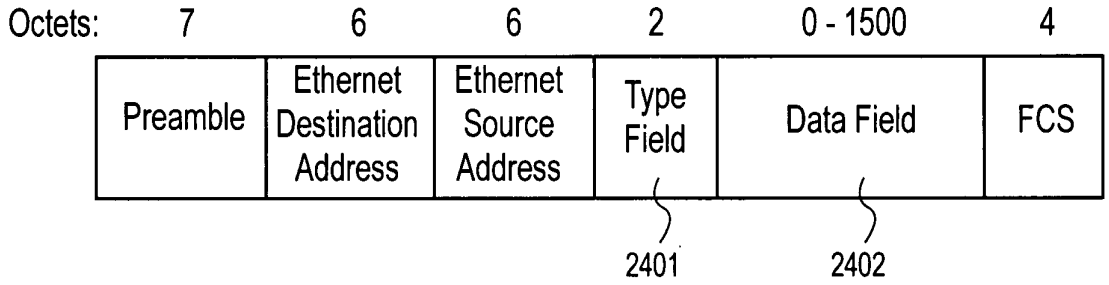


FIG. 24A

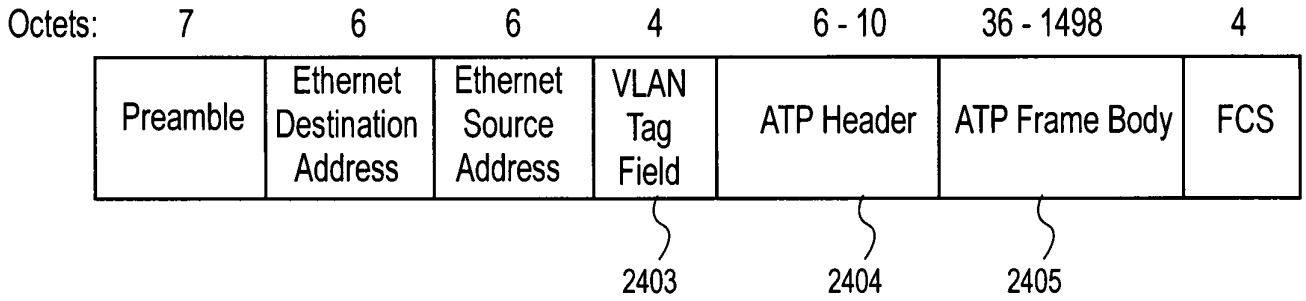


FIG. 24B

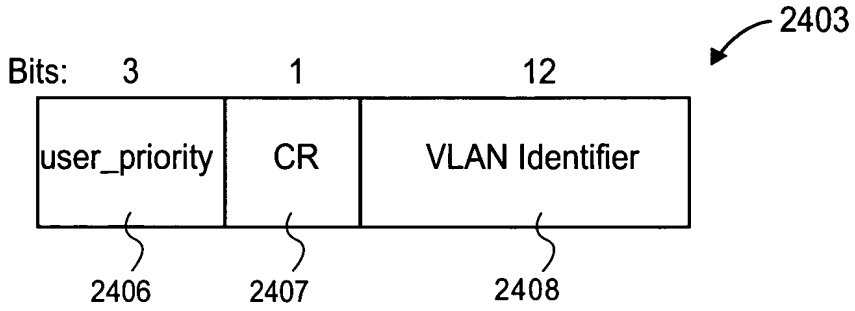


FIG. 24C

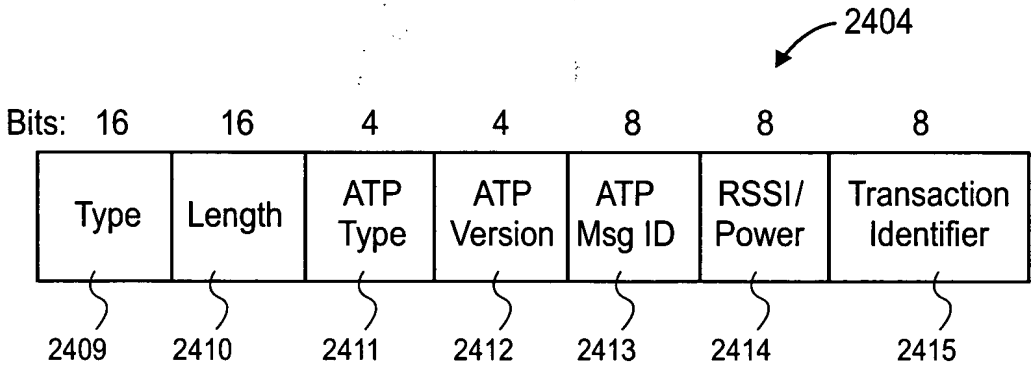


FIG. 24D

Msg ID categories	ID value	Message
Switch to Repeater 2501	0x00	Initialize Repeater
	0x01	Available
	0x02	Available
	0x03	Reset Repeater
	0x04	Switch Heartbeat Message
	0x05	Beacon Frame Message
	0x06	Set Data Value
	0x07	Get Data Value
	0x08	Assign Token
	0x09	Delete Token
	0x0A	Token List Query
	0x0B	Reserved
	0x0C	Assign VLAN Identifier
	0x0D	Available
	0x0E	Stdio
	0x0F	Repeater Acknowledgment
Repeater to Switch 2502	0x10	Initialize Repeater Response
	0x11 - 0x12	Available
	0x13	Reset Repeater Response
	0x14	Repeater Heartbeat Message
	0x15	Repeater Alarm
	0x16	Set Data Response
	0x17	Data Value Response
	0x18	Assign Token Response
	0x19	Delete Token Response
	0x1A	Token List Response
	0x1B	RSSI Info Message
	0x1C	Assign VLAN Identifier Response
	0x1D	Available
	0x1E	Stdio
	0x1F	Switch Acknowledgment
Switch to Mobile Station 2503	0x20 - 0x2B	Reserved
	0x2C	Outbound 802.11 Management Frame
	0x2D	Outbound 802.11 Control Frame
	0x2E	Outbound 802.11 Data Frame
	0x2F	Reserved
Mobile Station to Switch 2504	0x30 - 0x3B	Reserved
	0x3C	Inbound 802.11 Management Frame
	0x3D	Inbound 802.11 Control Frame
	0x3E	Inbound 802.11 Data Frame
	0x3F	Reserved
Reserved	0x40 - 0x7F	Reserved
Switch to Switch 2505	0x80	Distribution System Message
	0x81	Distribution System Message ACK
	0x82 - 0x8F	Available
Repeater to Repeater 2506	0x90 - 0x97	Available
	0x98	Assign Token
	0x99	Reserved
	0x9A	Assign Token Response
	0x9B	RSSI Info Message
	0x9C - 0x9F	Available
Reserved	0xA0 - 0xFF	Reserved

2507

2500

FIG. 25A

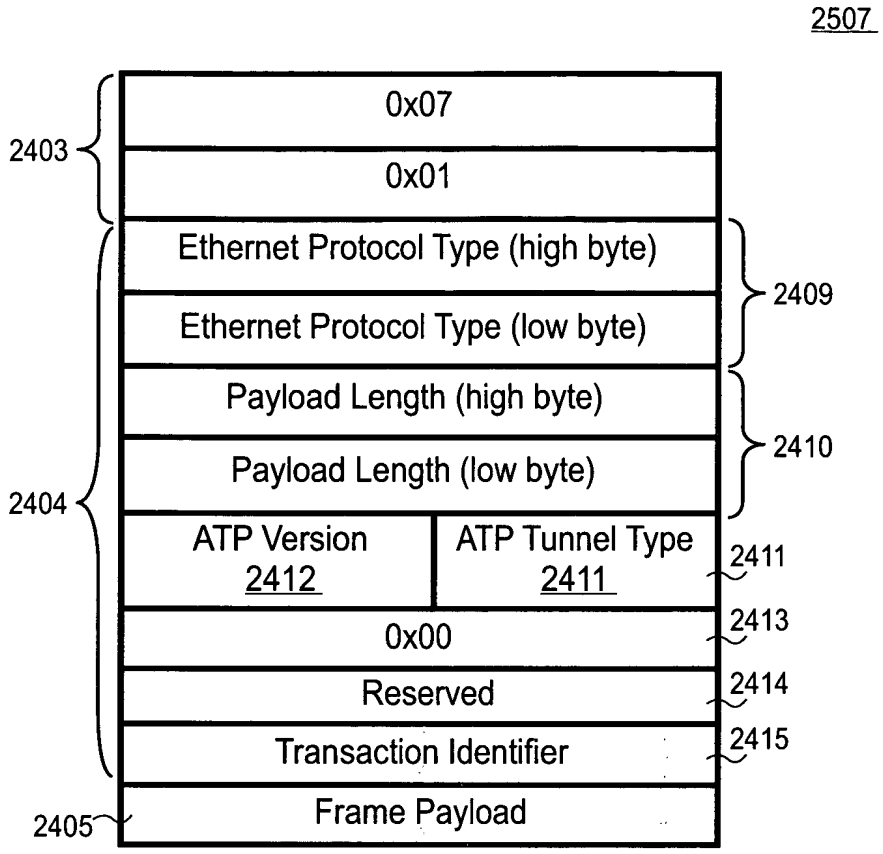


FIG. 25B

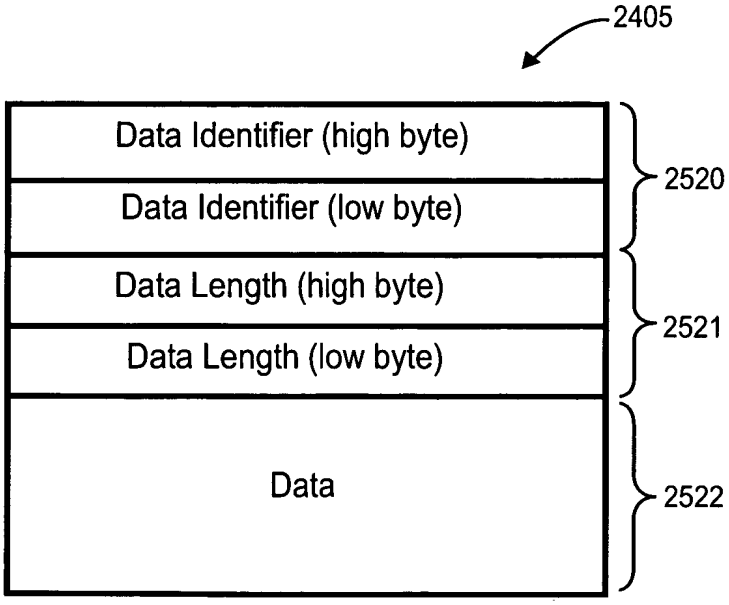


FIG. 25C

Data Name	Data Identifier	Data Length	Default Value	Read/Write
Reserved	0x0000			
Hardware Version	0x0001	Max 32-byte string	N/A	Read Only
Boot Firmware Version	0x0002	Max 32-byte string	N/A	Read Only
Software Version	0x0003	Max 32-byte string	N/A	Read Only
Time Of Day	0x0004	8-byte Time String in ISO 8601 format (HH:MM:SS)	00:00:00	R/W
Software Checksum	0x0005	4	N/A	Read Only
Available for system use	0x0006 - 0x001E	Variable length data		R/W
VLAN Configuration	0x001F			
BSSID	0x0020	6-byte string		R/W
Operating State	0x0021	2	3	R/W
Current Transmit Antenna	0x0022	2	3	R/W
Current Receive Antenna	0x0023	2	3	R/W
Current Transmit Power Level	0x0024	2	100	R/W
Current Channel	0x0025	2	6	R/W

FIG. 26A

Current CCA Mode	0x0026	2	2	R/W
ED Threshold	0x0027	2	0	R/W
Short Retry Limit	0x0028	2	7	R/W
Long Retry Limit	0x0029	2	4	R/W
RSSI Filter Control	0x002A	2	0	R/W
RSSI Filter Threshold	0x002B	2	0	R/W
RTS Threshold	0x002C	2	2347	R/W
Heartbeat Interval	0x002D	2	1	R/W
IP Address	0x002E	4		R/W
SSID	0x002F			R/W
Beacon Interval	0x0030	2	100	R/W
Broadcast SSID	0x0031	2	0	R/W
MTU	0x0032	2	1024	R/W
Available for configuration use	0x0033 - 0x003D			

FIG. 26A (CONT.)

Data Name	Data Identifier	Data Length	Default Value	Read/Write
Packet Antenna ID	0x3E	2	0	R/W
Mode	0x3F	2	0	R/W
Failed Count	0x0040	4	0	R/Reset Only
Retry Count	0x0041	4	0	R/Reset Only
Multiple Retry Count	0x0042	4	0	R/Reset Only
Frame Duplicate Count	0x0043	4	0	R/Reset Only
RTS Success Count	0x0044	4	0	R/Reset Only
RTS Failure Count	0x0045	4	0	R/Reset Only
ACK Failure Count	0x0046	4	0	R/Reset Only
Received Fragment Count	0x0047	4	0	R/Reset Only
FCS Error Count	0x0048	4	0	R/Reset Only
Transmitted Frame Count	0x0049	4	0	R/Reset Only
Up Time (seconds)	0x004A	4	0	Read Only
Current Active Token Count	0x004B	4	0	Read Only

FIG. 26B

Maximum Active Token Count	0x004C	4	0	Read Only
Beacon Count	0x004D	4	0	R/Reset Only
Available for statistics use	0x004E - 0x005F			
Firmware Download	0x0060	Variable length data		Write Only
Reserved	0x0070 - 0xFFFF			

FIG. 26B (CONT.)

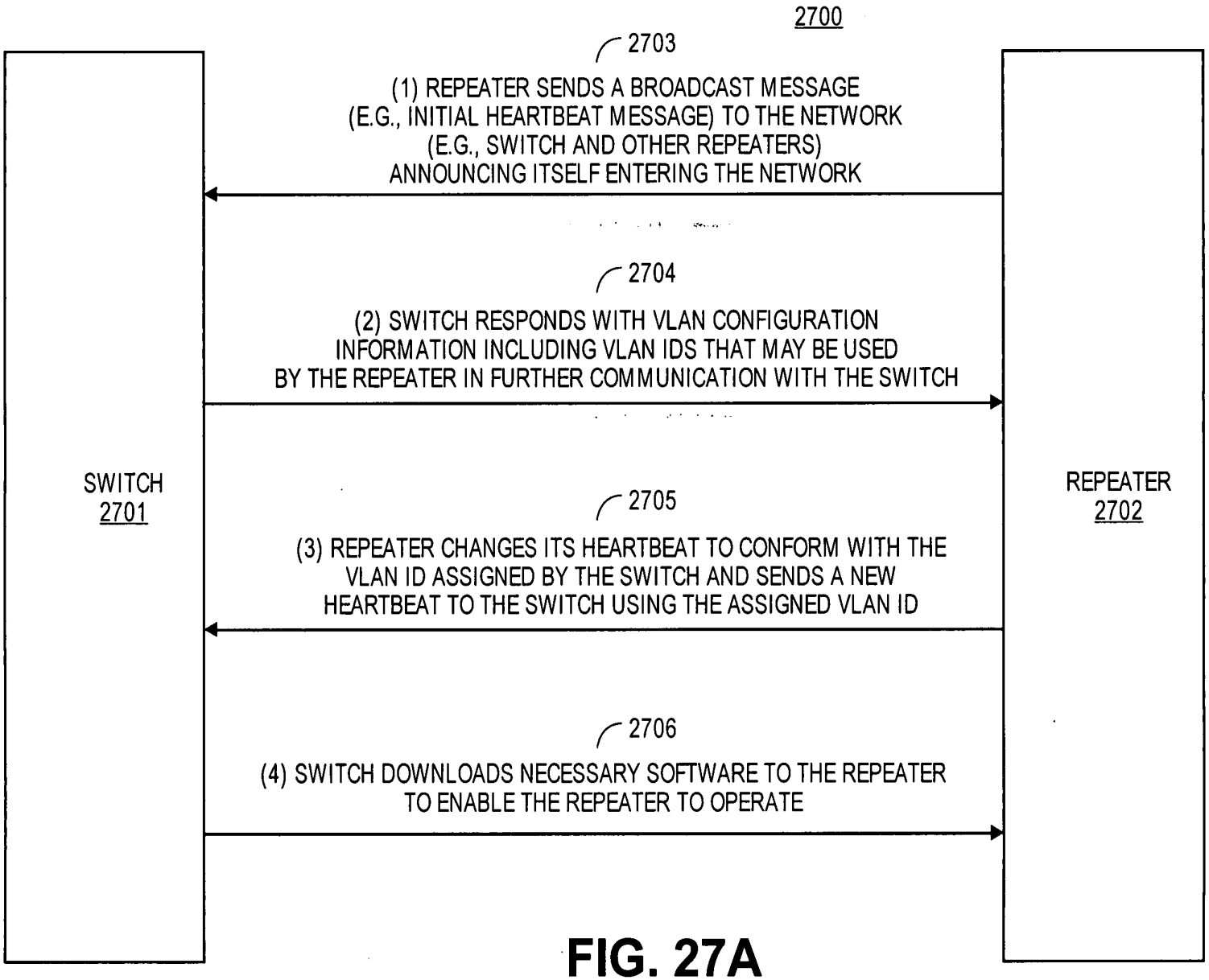

2700
2703
(1) REPEATER SENDS A BROADCAST MESSAGE
(E.G., INITIAL HEARTBEAT MESSAGE) TO THE NETWORK
(E.G., SWITCH AND OTHER REPEATERS)
ANNOUNCING ITSELF ENTERING THE NETWORK
2704
(2) SWITCH RESPONDS WITH VLAN CONFIGURATION
INFORMATION INCLUDING VLAN IDS THAT MAY BE USED
BY THE REPEATER IN FURTHER COMMUNICATION WITH THE SWITCH
SWITCH
2701
2705
(3) REPEATER CHANGES ITS HEARTBEAT TO CONFORM WITH THE
VLAN ID ASSIGNED BY THE SWITCH AND SENDS A NEW
HEARTBEAT TO THE SWITCH USING THE ASSIGNED VLAN ID
REPEATER
2702
2706
(4) SWITCH DOWNLOADS NECESSARY SOFTWARE TO THE REPEATER
TO ENABLE THE REPEATER TO OPERATE

FIG. 27A

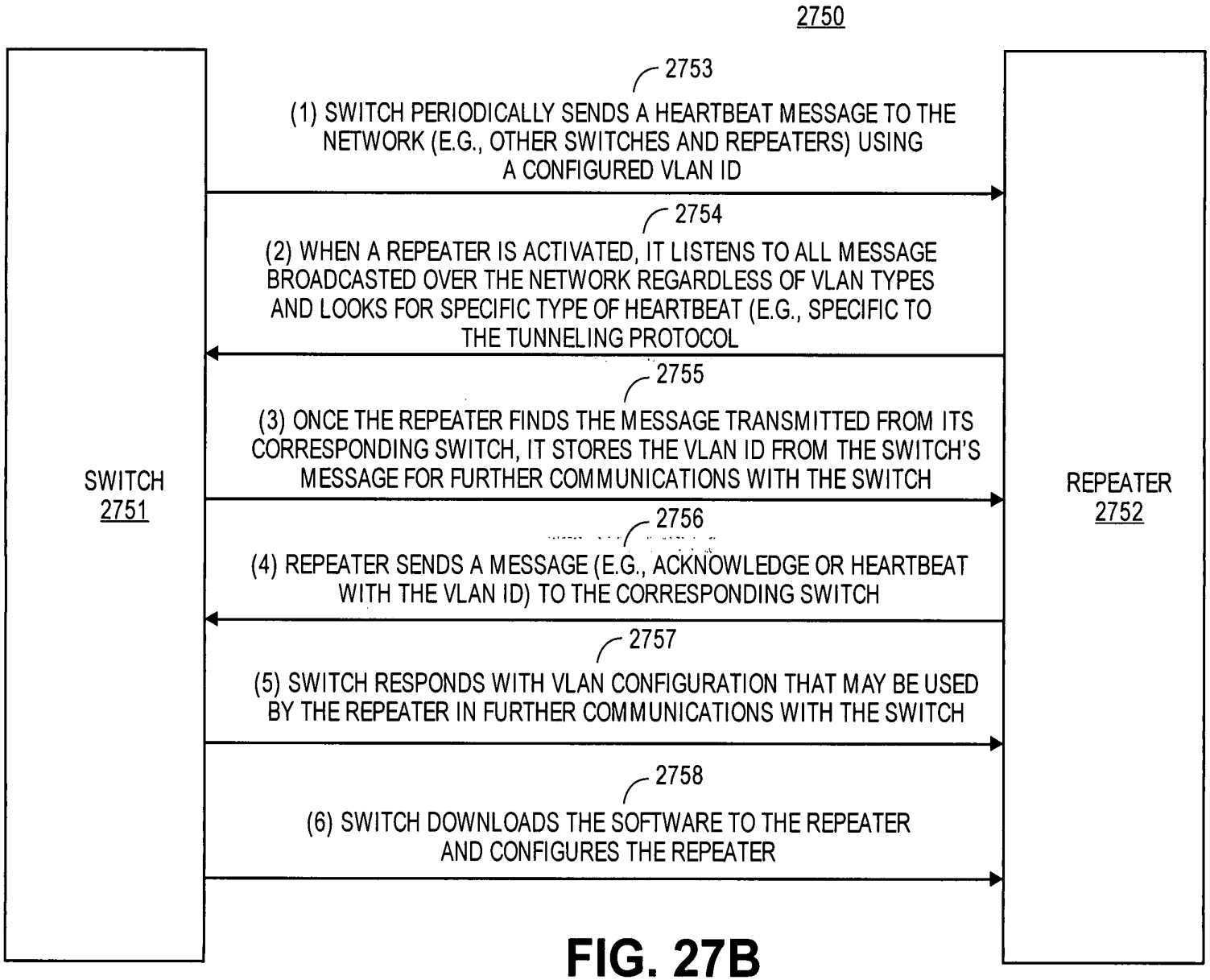

2750
SWITCH
2751
REPEATER
2752
2753
(1) SWITCH PERIODICALLY SENDS A HEARTBEAT MESSAGE TO THE NETWORK (E.G., OTHER SWITCHES AND REPEATERS) USING A CONFIGURED VLAN ID
2754
(2) WHEN A REPEATER IS ACTIVATED, IT LISTENS TO ALL MESSAGE BROADCASTED OVER THE NETWORK REGARDLESS OF VLAN TYPES AND LOOKS FOR SPECIFIC TYPE OF HEARTBEAT (E.G., SPECIFIC TO THE TUNNELING PROTOCOL
2755
(3) ONCE THE REPEATER FINDS THE MESSAGE TRANSMITTED FROM ITS CORRESPONDING SWITCH, IT STORES THE VLAN ID FROM THE SWITCH'S MESSAGE FOR FURTHER COMMUNICATIONS WITH THE SWITCH
2756
(4) REPEATER SENDS A MESSAGE (E.G., ACKNOWLEDGE OR HEARTBEAT WITH THE VLAN ID) TO THE CORRESPONDING SWITCH
2757
(5) SWITCH RESPONDS WITH VLAN CONFIGURATION THAT MAY BE USED BY THE REPEATER IN FURTHER COMMUNICATIONS WITH THE SWITCH
2758
(6) SWITCH DOWNLOADS THE SOFTWARE TO THE REPEATER AND CONFIGURES THE REPEATER

FIG. 27B

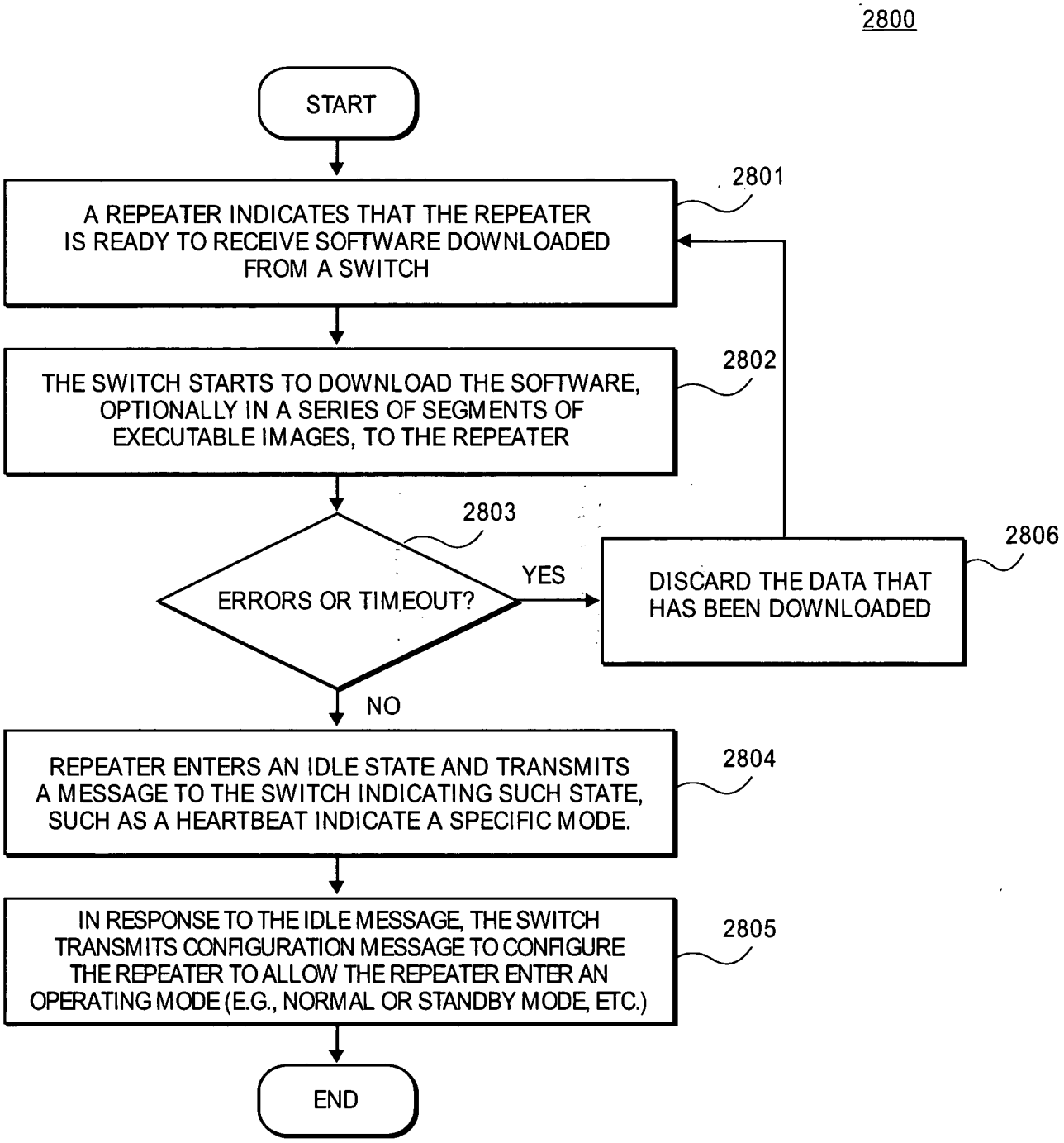

2800
START
2801
A REPEATER INDICATES THAT THE REPEATER IS READY TO RECEIVE SOFTWARE DOWNLOADED FROM A SWITCH
2802
THE SWITCH STARTS TO DOWNLOAD THE SOFTWARE, OPTIONALLY IN A SERIES OF SEGMENTS OF EXECUTABLE IMAGES, TO THE REPEATER
2803
ERRORS OR TIMEOUT?
YES
2806
DISCARD THE DATA THAT HAS BEEN DOWNLOADED
NO
2804
REPEATER ENTERS AN IDLE STATE AND TRANSMITS A MESSAGE TO THE SWITCH INDICATING SUCH STATE, SUCH AS A HEARTBEAT INDICATE A SPECIFIC MODE.
2805
IN RESPONSE TO THE IDLE MESSAGE, THE SWITCH TRANSMITS CONFIGURATION MESSAGE TO CONFIGURE THE REPEATER TO ALLOW THE REPEATER ENTER AN OPERATING MODE (E.G., NORMAL OR STANDBY MODE, ETC.)
END

FIG. 28

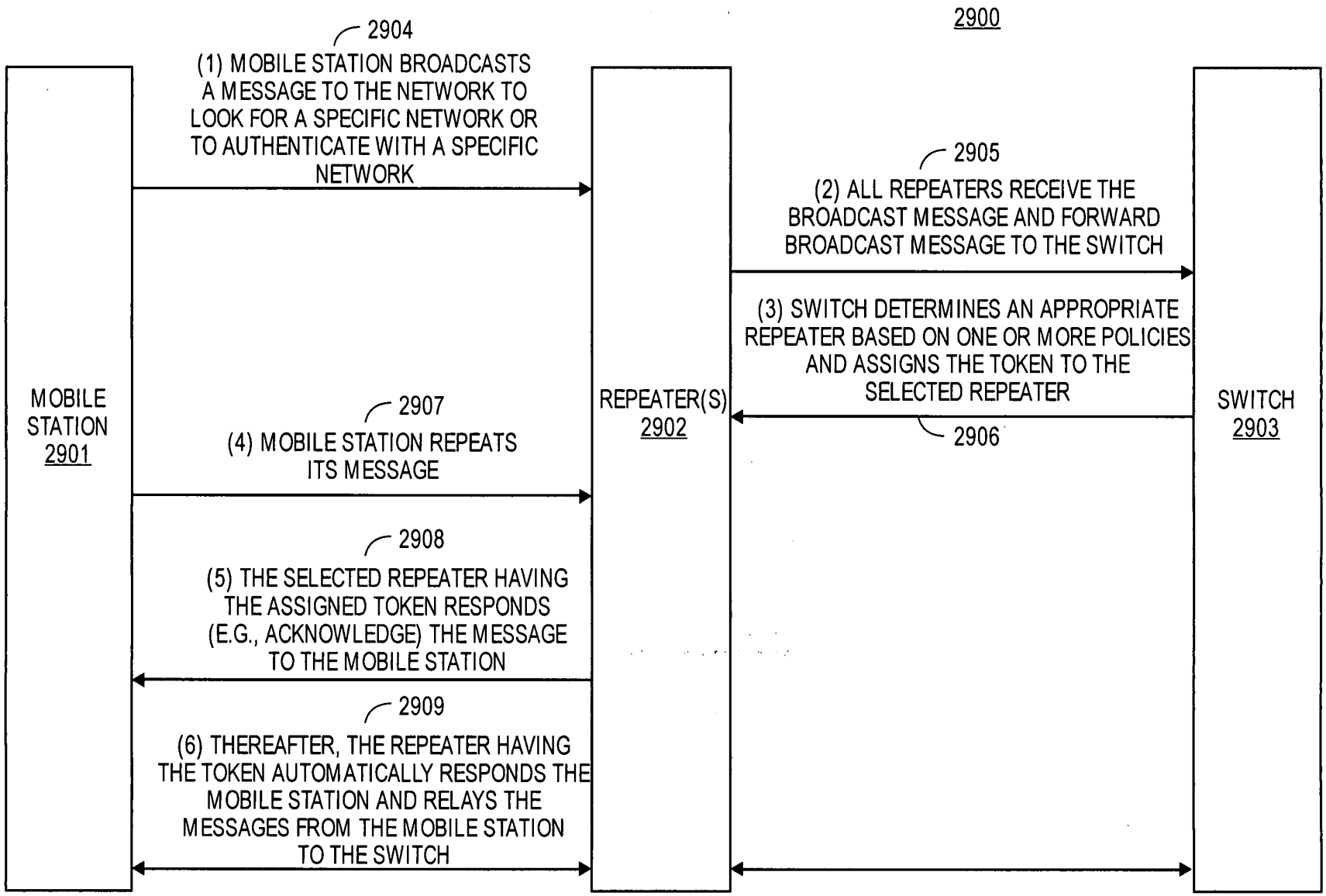

2900
2904
(1) MOBILE STATION BROADCASTS A MESSAGE TO THE NETWORK TO LOOK FOR A SPECIFIC NETWORK OR TO AUTHENTICATE WITH A SPECIFIC NETWORK
2905
(2) ALL REPEATERS RECEIVE THE BROADCAST MESSAGE AND FORWARD BROADCAST MESSAGE TO THE SWITCH
(3) SWITCH DETERMINES AN APPROPRIATE REPEATER BASED ON ONE OR MORE POLICIES AND ASSIGNS THE TOKEN TO THE SELECTED REPEATER
2906
2907
(4) MOBILE STATION REPEATS ITS MESSAGE
2908
(5) THE SELECTED REPEATER HAVING THE ASSIGNED TOKEN RESPONDS (E.G., ACKNOWLEDGE) THE MESSAGE TO THE MOBILE STATION
2909
(6) THEREAFTER, THE REPEATER HAVING THE TOKEN AUTOMATICALLY RESPONDS THE MOBILE STATION AND RELAYS THE MESSAGES FROM THE MOBILE STATION TO THE SWITCH
MOBILE STATION 2901
REPEATER(S) 2902
SWITCH 2903

FIG. 29

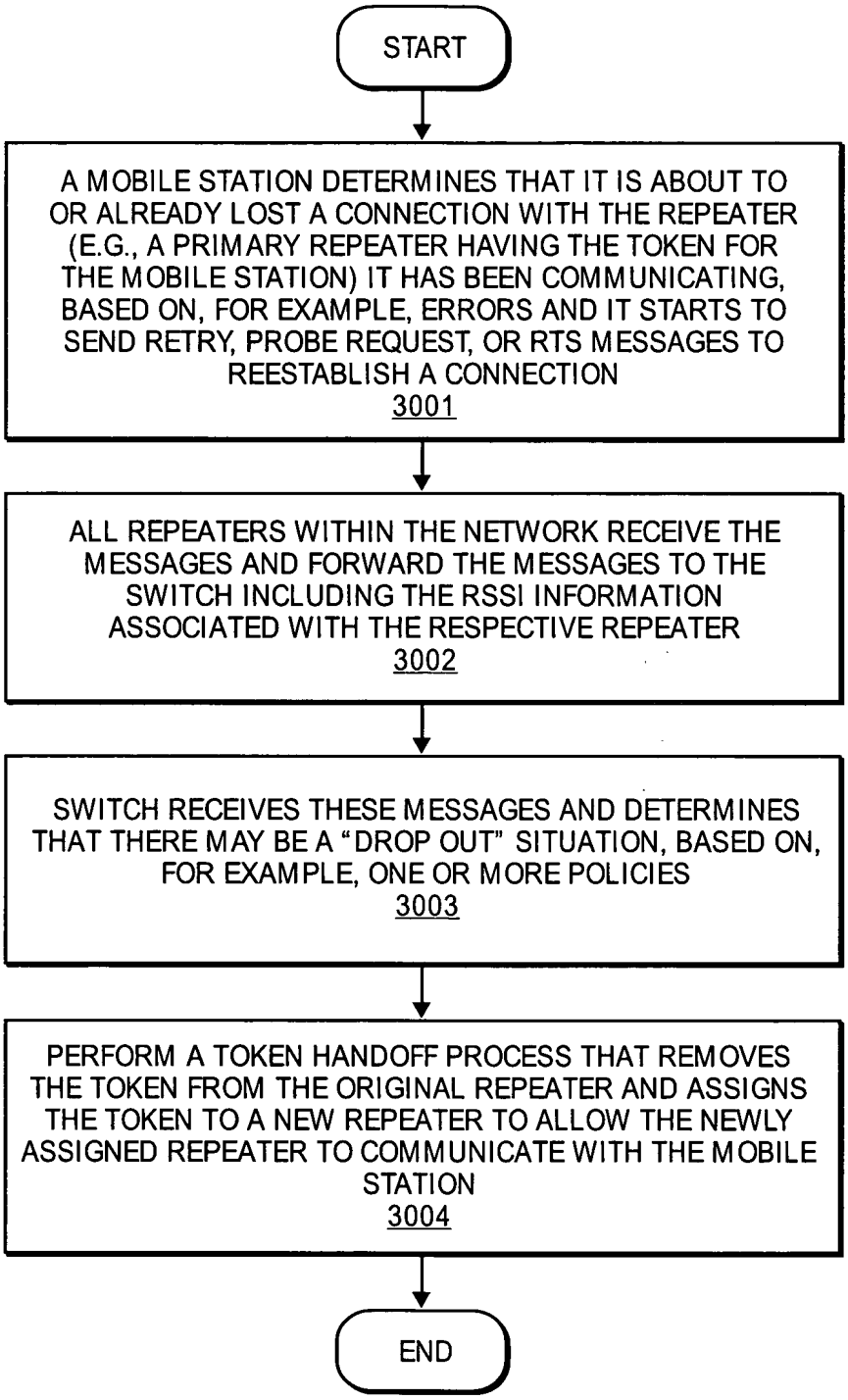

3000
START
A MOBILE STATION DETERMINES THAT IT IS ABOUT TO OR ALREADY LOST A CONNECTION WITH THE REPEATER (E.G., A PRIMARY REPEATER HAVING THE TOKEN FOR THE MOBILE STATION) IT HAS BEEN COMMUNICATING, BASED ON, FOR EXAMPLE, ERRORS AND IT STARTS TO SEND RETRY, PROBE REQUEST, OR RTS MESSAGES TO REESTABLISH A CONNECTION
3001
ALL REPEATERS WITHIN THE NETWORK RECEIVE THE MESSAGES AND FORWARD THE MESSAGES TO THE SWITCH INCLUDING THE RSSI INFORMATION ASSOCIATED WITH THE RESPECTIVE REPEATER
3002
SWITCH RECEIVES THESE MESSAGES AND DETERMINES THAT THERE MAY BE A "DROP OUT" SITUATION, BASED ON, FOR EXAMPLE, ONE OR MORE POLICIES
3003
PERFORM A TOKEN HANDOFF PROCESS THAT REMOVES THE TOKEN FROM THE ORIGINAL REPEATER AND ASSIGNS THE TOKEN TO A NEW REPEATER TO ALLOW THE NEWLY ASSIGNED REPEATER TO COMMUNICATE WITH THE MOBILE STATION
3004
END

FIG. 30A

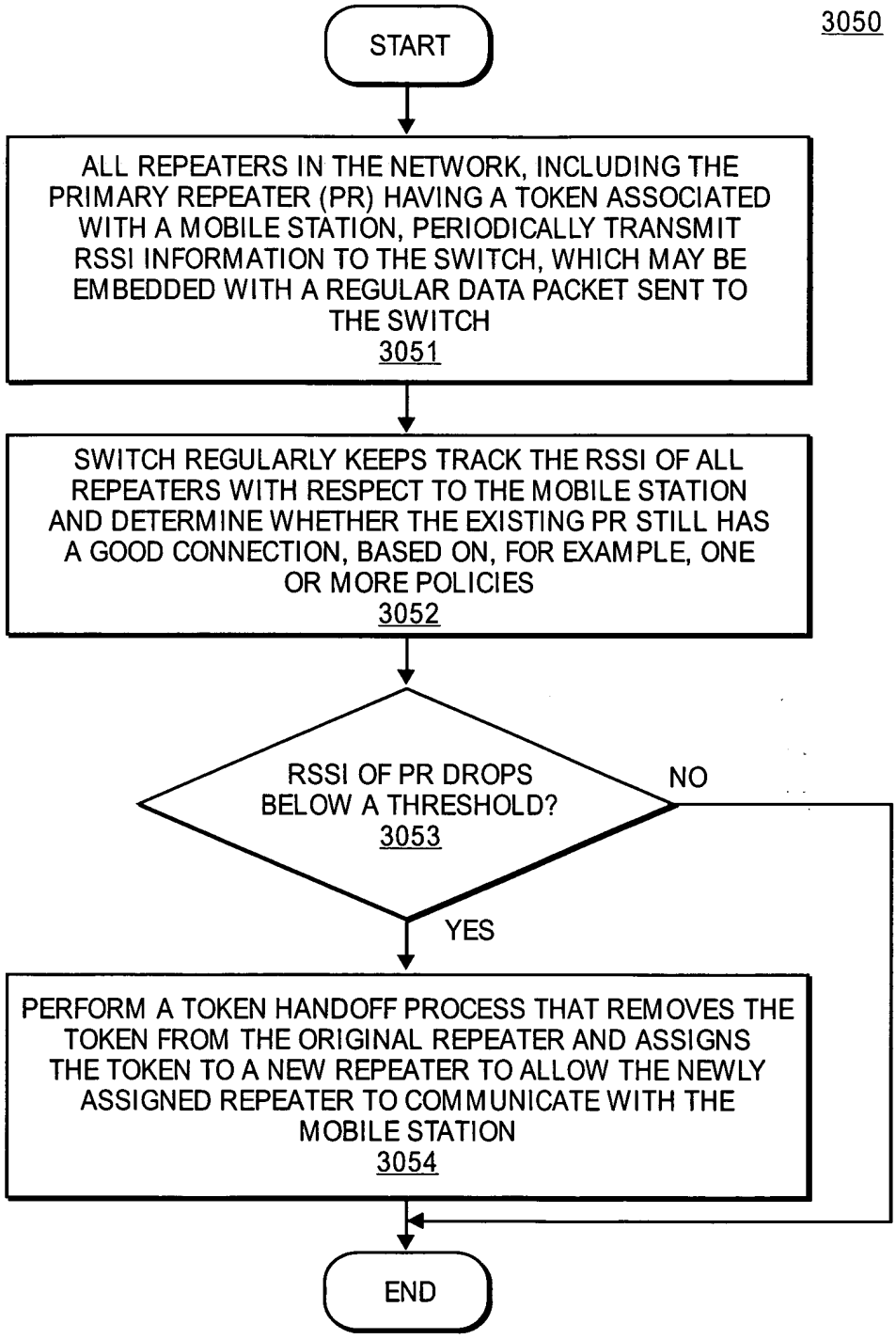

3050
START
ALL REPEATERS IN THE NETWORK, INCLUDING THE PRIMARY REPEATER (PR) HAVING A TOKEN ASSOCIATED WITH A MOBILE STATION, PERIODICALLY TRANSMIT RSSI INFORMATION TO THE SWITCH, WHICH MAY BE EMBEDDED WITH A REGULAR DATA PACKET SENT TO THE SWITCH
3051
SWITCH REGULARLY KEEPS TRACK THE RSSI OF ALL REPEATERS WITH RESPECT TO THE MOBILE STATION AND DETERMINE WHETHER THE EXISTING PR STILL HAS A GOOD CONNECTION, BASED ON, FOR EXAMPLE, ONE OR MORE POLICIES
3052
RSSI OF PR DROPS BELOW A THRESHOLD?
3053
NO
YES
PERFORM A TOKEN HANDOFF PROCESS THAT REMOVES THE TOKEN FROM THE ORIGINAL REPEATER AND ASSIGNS THE TOKEN TO A NEW REPEATER TO ALLOW THE NEWLY ASSIGNED REPEATER TO COMMUNICATE WITH THE MOBILE STATION
3054
END

FIG. 30B

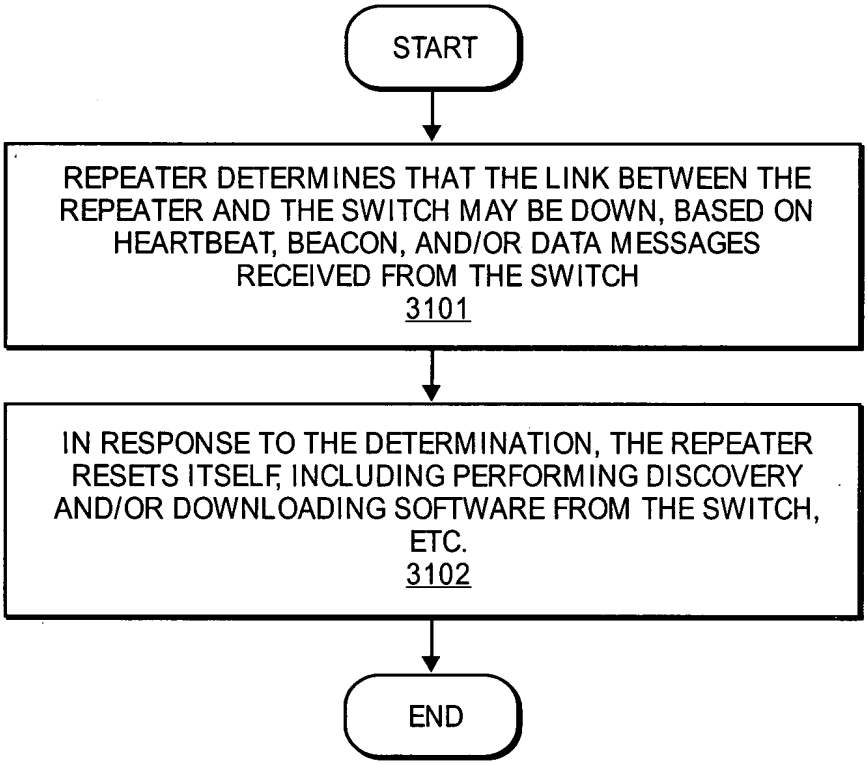

3100
START
REPEATER DETERMINES THAT THE LINK BETWEEN THE REPEATER AND THE SWITCH MAY BE DOWN, BASED ON HEARTBEAT, BEACON, AND/OR DATA MESSAGES RECEIVED FROM THE SWITCH
3101
IN RESPONSE TO THE DETERMINATION, THE REPEATER RESETS ITSELF, INCLUDING PERFORMING DISCOVERY AND/OR DOWNLOADING SOFTWARE FROM THE SWITCH, ETC.
3102
END

FIG. 31A

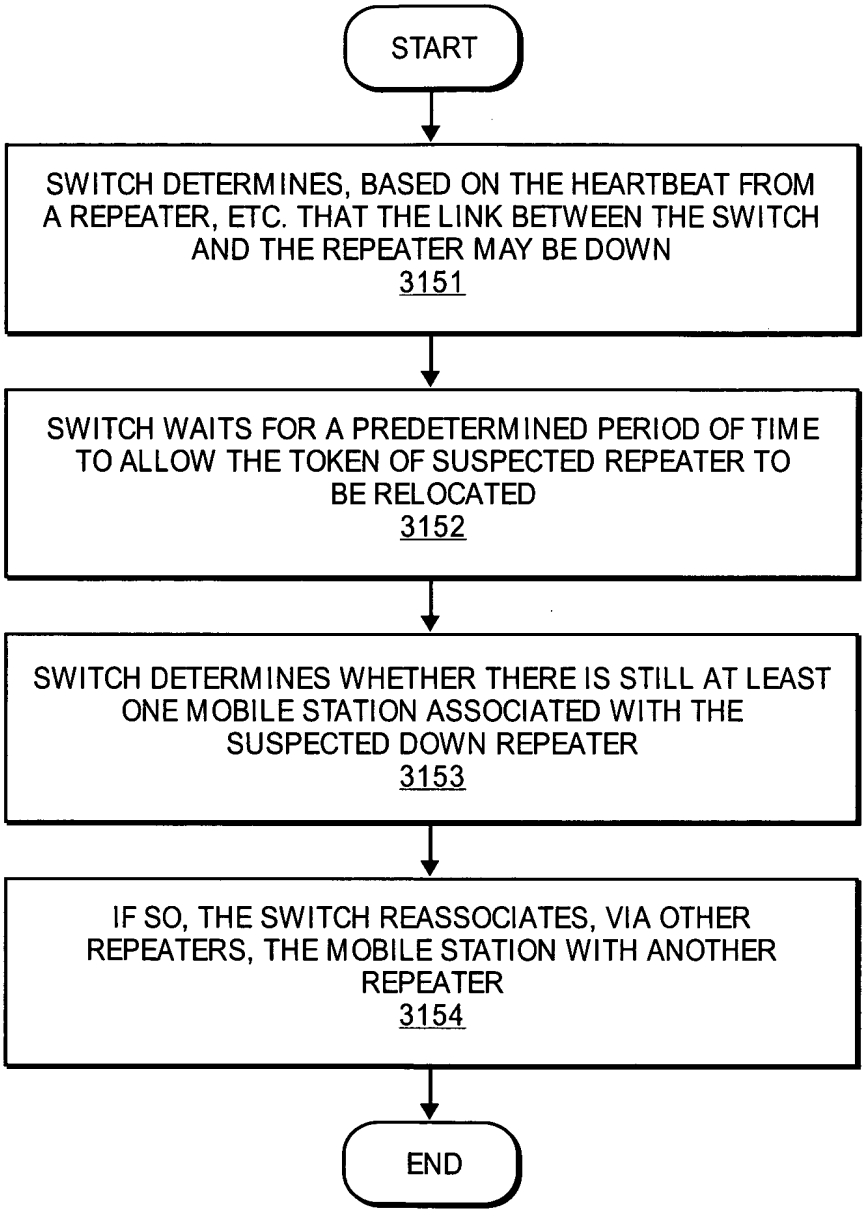

3150
START
SWITCH DETERMINES, BASED ON THE HEARTBEAT FROM A REPEATER, ETC. THAT THE LINK BETWEEN THE SWITCH AND THE REPEATER MAY BE DOWN
3151
SWITCH WAITS FOR A PREDETERMINED PERIOD OF TIME TO ALLOW THE TOKEN OF SUSPECTED REPEATER TO BE RELOCATED
3152
SWITCH DETERMINES WHETHER THERE IS STILL AT LEAST ONE MOBILE STATION ASSOCIATED WITH THE SUSPECTED DOWN REPEATER
3153
IF SO, THE SWITCH REASSOCIATES, VIA OTHER REPEATERS, THE MOBILE STATION WITH ANOTHER REPEATER
3154
END

FIG. 31B

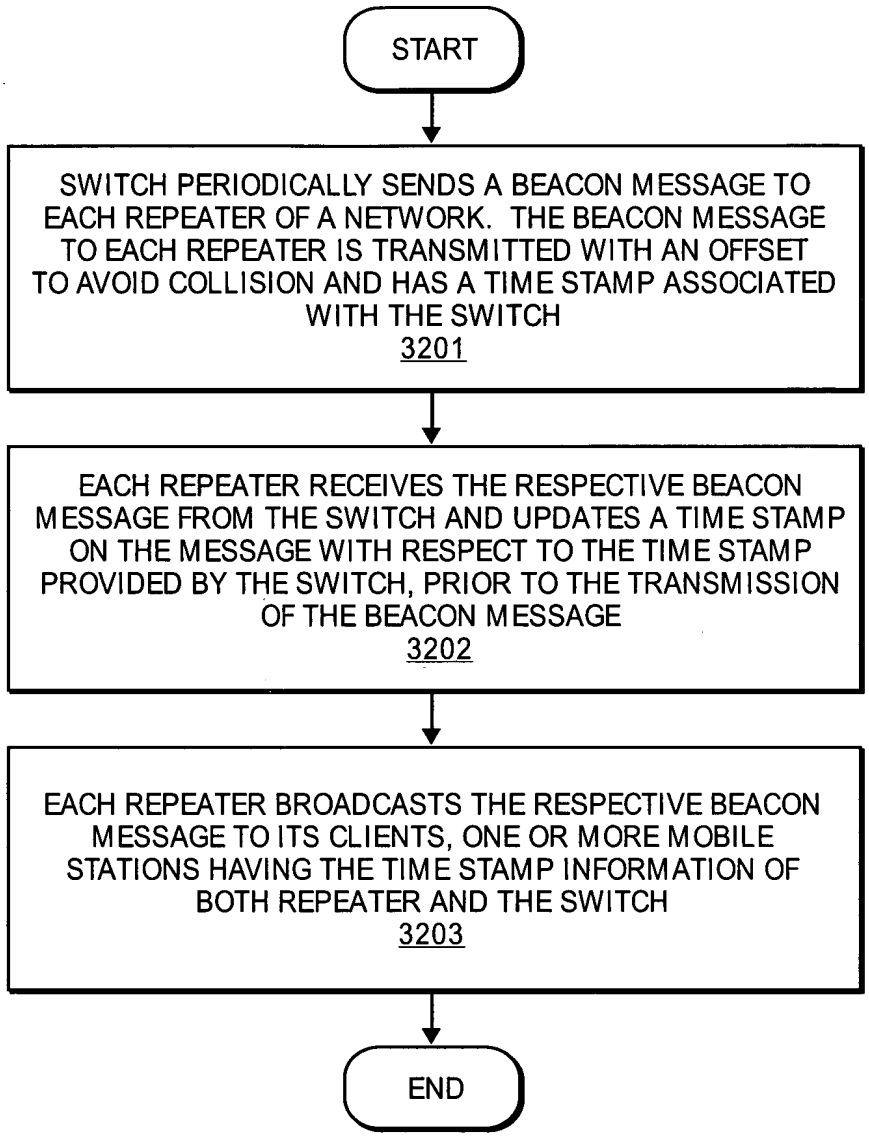

3200
START
SWITCH PERIODICALLY SENDS A BEACON MESSAGE TO EACH REPEATER OF A NETWORK. THE BEACON MESSAGE TO EACH REPEATER IS TRANSMITTED WITH AN OFFSET TO AVOID COLLISION AND HAS A TIME STAMP ASSOCIATED WITH THE SWITCH
3201
EACH REPEATER RECEIVES THE RESPECTIVE BEACON MESSAGE FROM THE SWITCH AND UPDATES A TIME STAMP ON THE MESSAGE WITH RESPECT TO THE TIME STAMP PROVIDED BY THE SWITCH, PRIOR TO THE TRANSMISSION OF THE BEACON MESSAGE
3202
EACH REPEATER BROADCASTS THE RESPECTIVE BEACON MESSAGE TO ITS CLIENTS, ONE OR MORE MOBILE STATIONS HAVING THE TIME STAMP INFORMATION OF BOTH REPEATER AND THE SWITCH
3203
END

FIG. 32

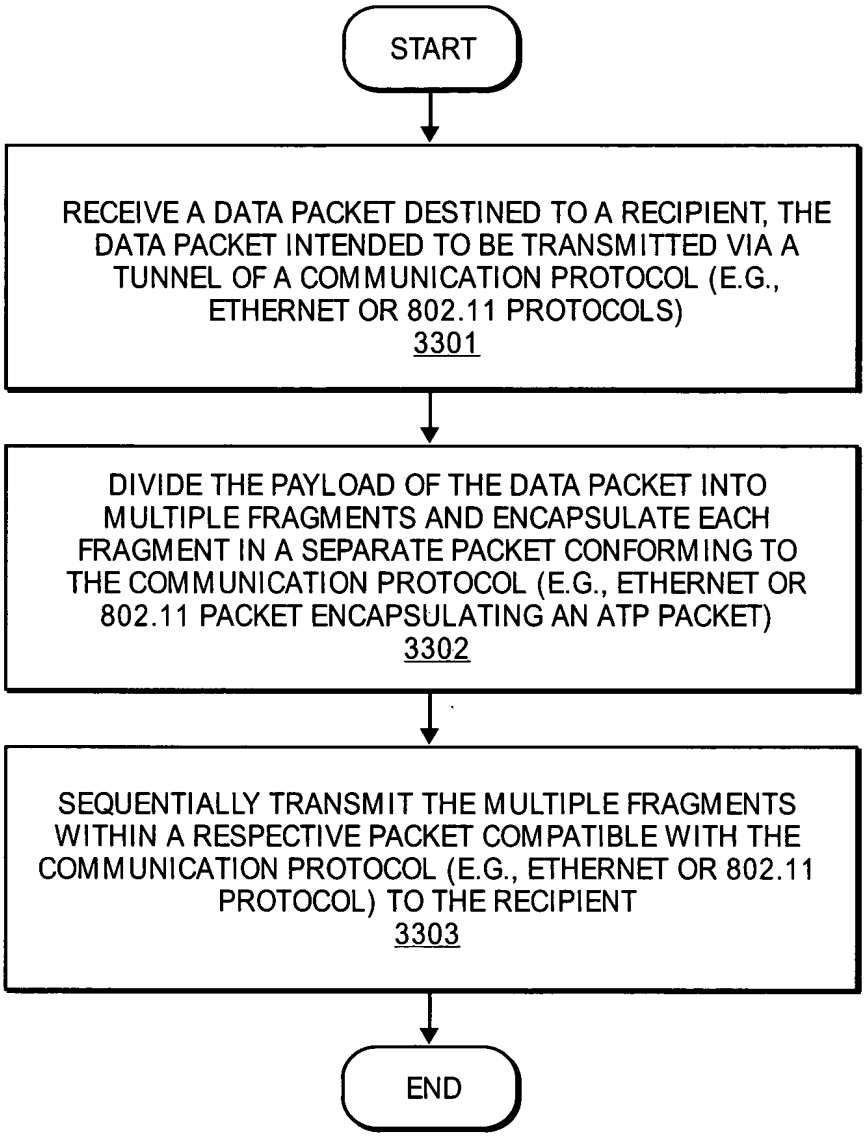

3300
START
RECEIVE A DATA PACKET DESTINED TO A RECIPIENT, THE DATA PACKET INTENDED TO BE TRANSMITTED VIA A TUNNEL OF A COMMUNICATION PROTOCOL (E.G., ETHERNET OR 802.11 PROTOCOLS)
3301
DIVIDE THE PAYLOAD OF THE DATA PACKET INTO MULTIPLE FRAGMENTS AND ENCAPSULATE EACH FRAGMENT IN A SEPARATE PACKET CONFORMING TO THE COMMUNICATION PROTOCOL (E.G., ETHERNET OR 802.11 PACKET ENCAPSULATING AN ATP PACKET)
3302
SEQUENTIALLY TRANSMIT THE MULTIPLE FRAGMENTS WITHIN A RESPECTIVE PACKET COMPATIBLE WITH THE COMMUNICATION PROTOCOL (E.G., ETHERNET OR 802.11 PROTOCOL) TO THE RECIPIENT
3303
END

FIG. 33A

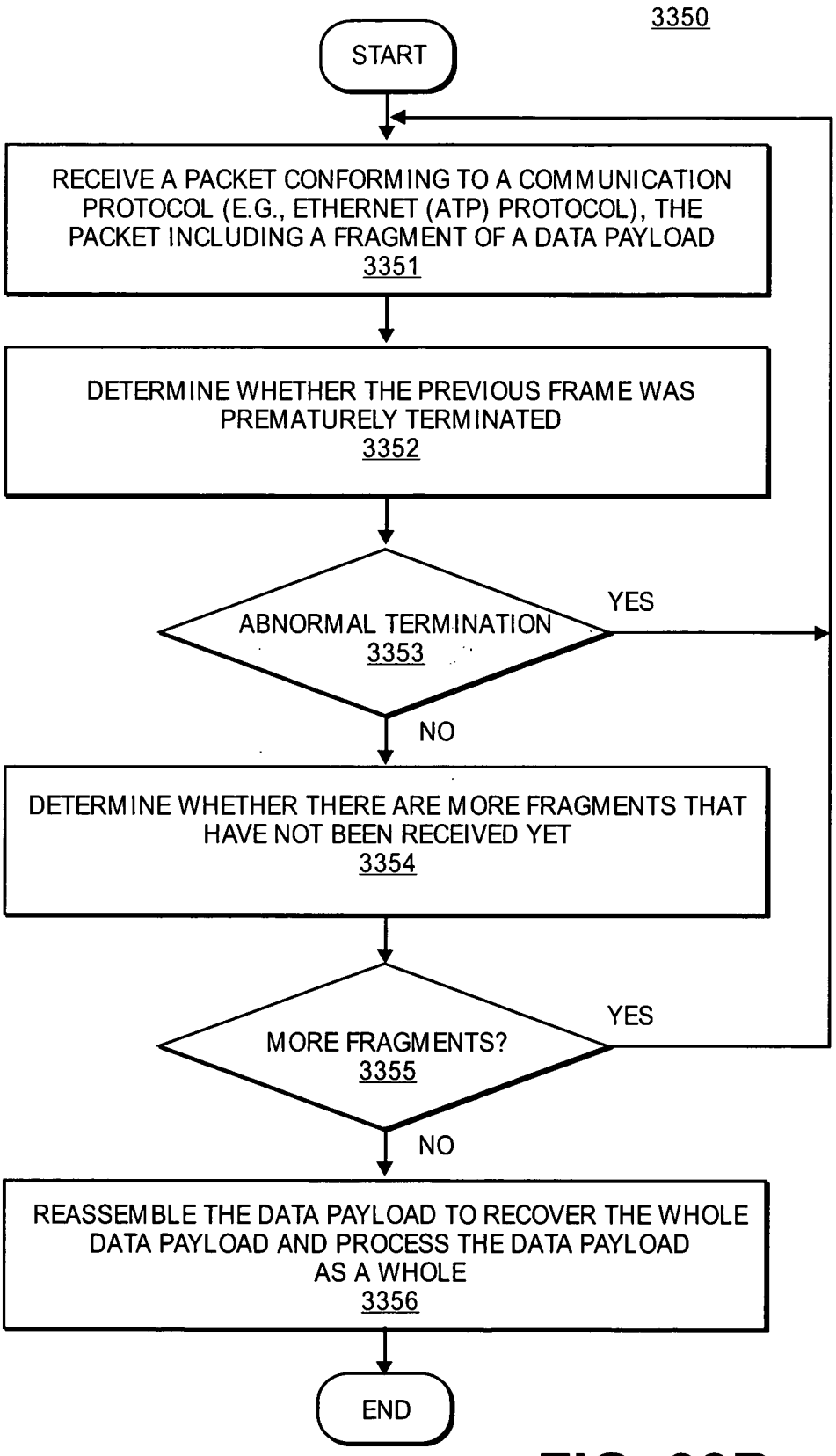
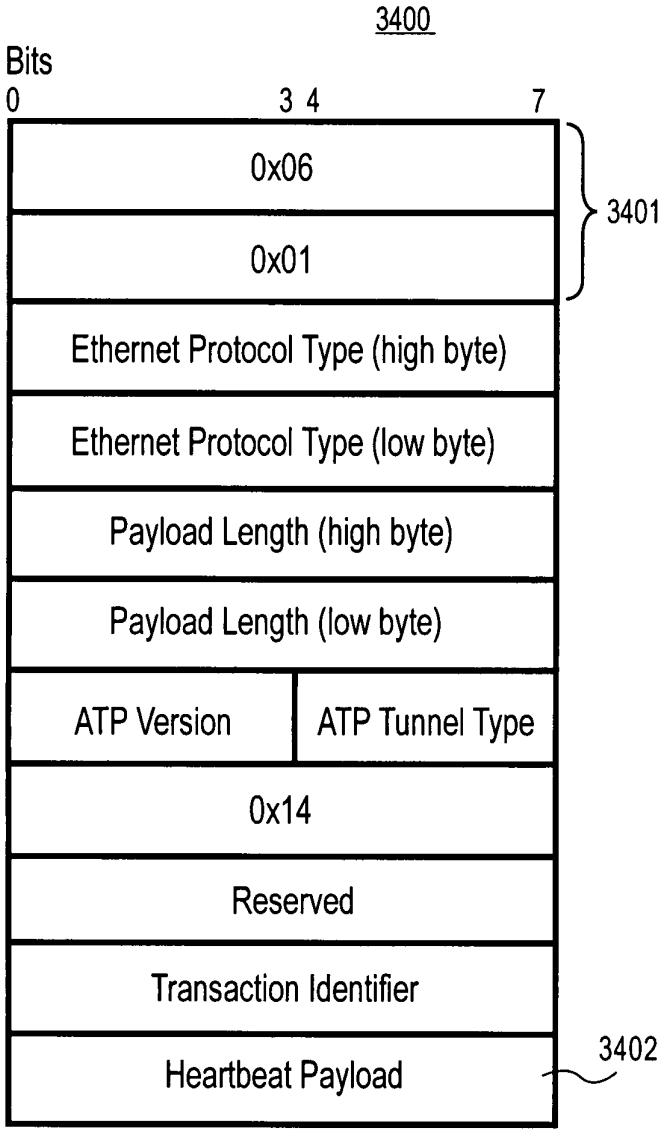
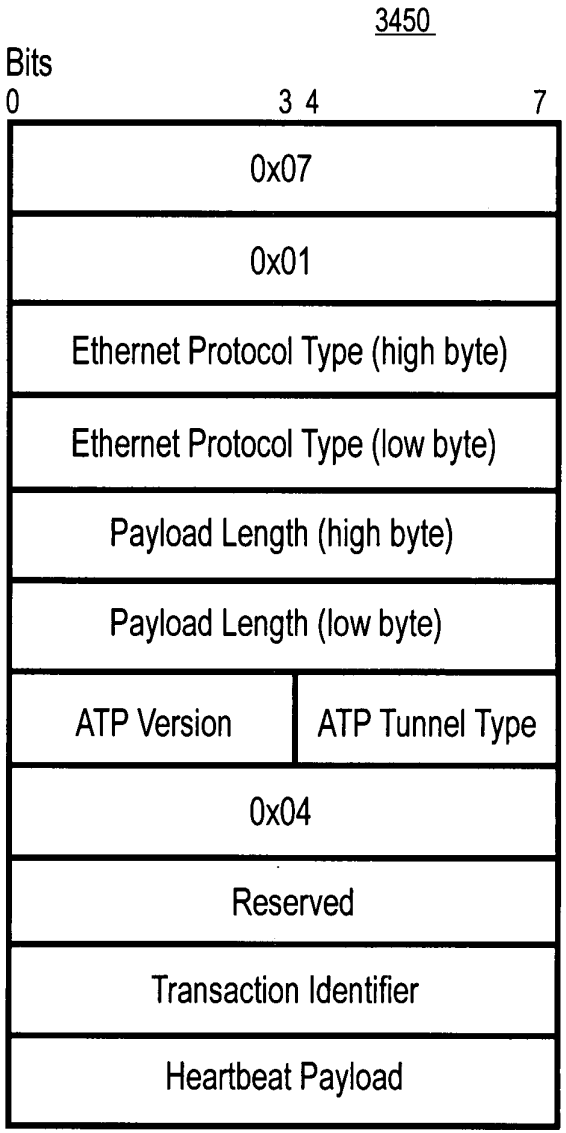

3350
START
RECEIVE A PACKET CONFORMING TO A COMMUNICATION PROTOCOL (E.G., ETHERNET (ATP) PROTOCOL), THE PACKET INCLUDING A FRAGMENT OF A DATA PAYLOAD
3351
DETERMINE WHETHER THE PREVIOUS FRAME WAS PREMATURELY TERMINATED
3352
ABNORMAL TERMINATION
3353
YES
NO
DETERMINE WHETHER THERE ARE MORE FRAGMENTS THAT HAVE NOT BEEN RECEIVED YET
3354
MORE FRAGMENTS?
3355
YES
NO
REASSEMBLE THE DATA PAYLOAD TO RECOVER THE WHOLE DATA PAYLOAD AND PROCESS THE DATA PAYLOAD AS A WHOLE
3356
END

FIG. 33B



Repeater Heartbeat Message Frame Format

FIG. 34A



Switch Heartbeat Message

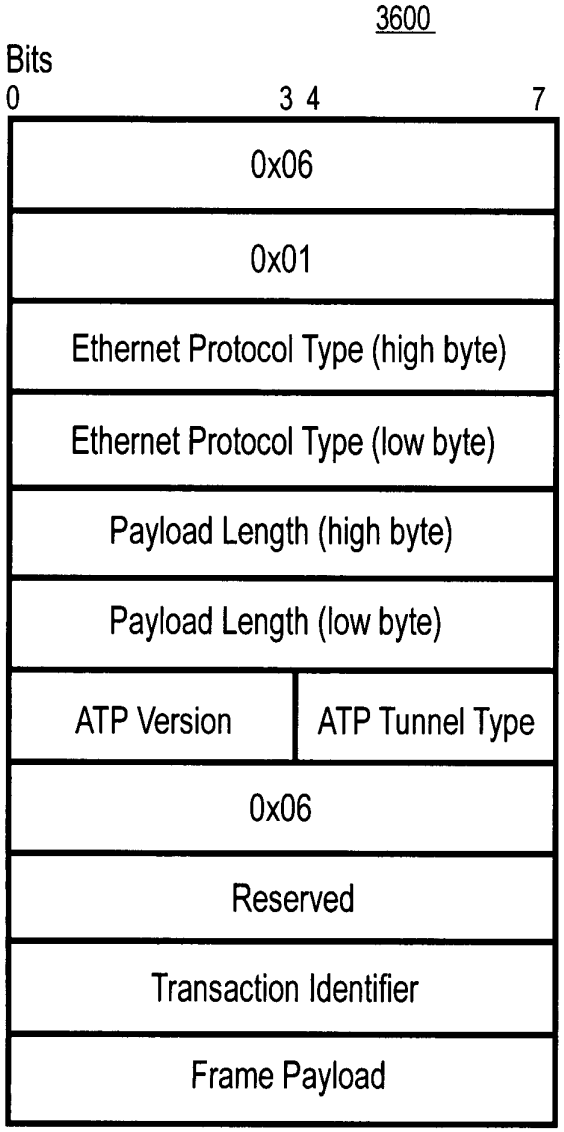
FIG. 34B

3500

Operating State	Value
Off	0
On	1
Standby	2
Uninitialized / Soft Reset	3
Reserved	4
Reserved	5
Reserved	6
Download	7
Not Loaded (Not Settable)	8
Echo	9
Reserved	0x0A
Available	0x0B
Available	0x0C
Available	0x0E
Hard Reset (privileged command)	0x0E
Discovery (Not Settable)	0x0F

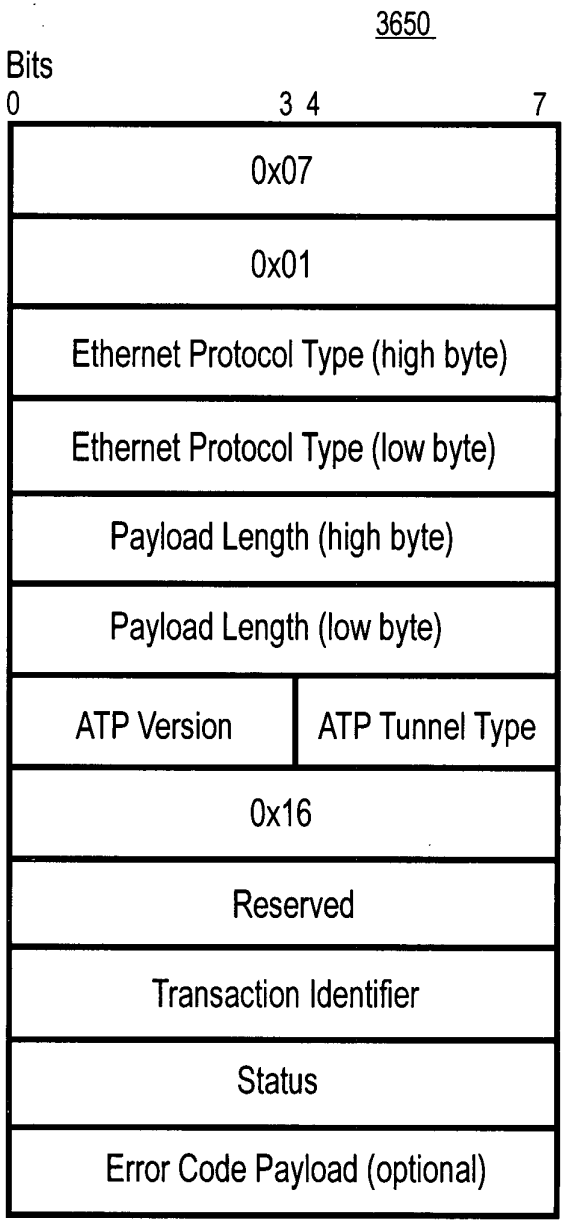
Operating State Definitions

FIG. 35



Set Data Value Frame Format

FIG. 36A



Set Data Response Frame Format

FIG. 36B

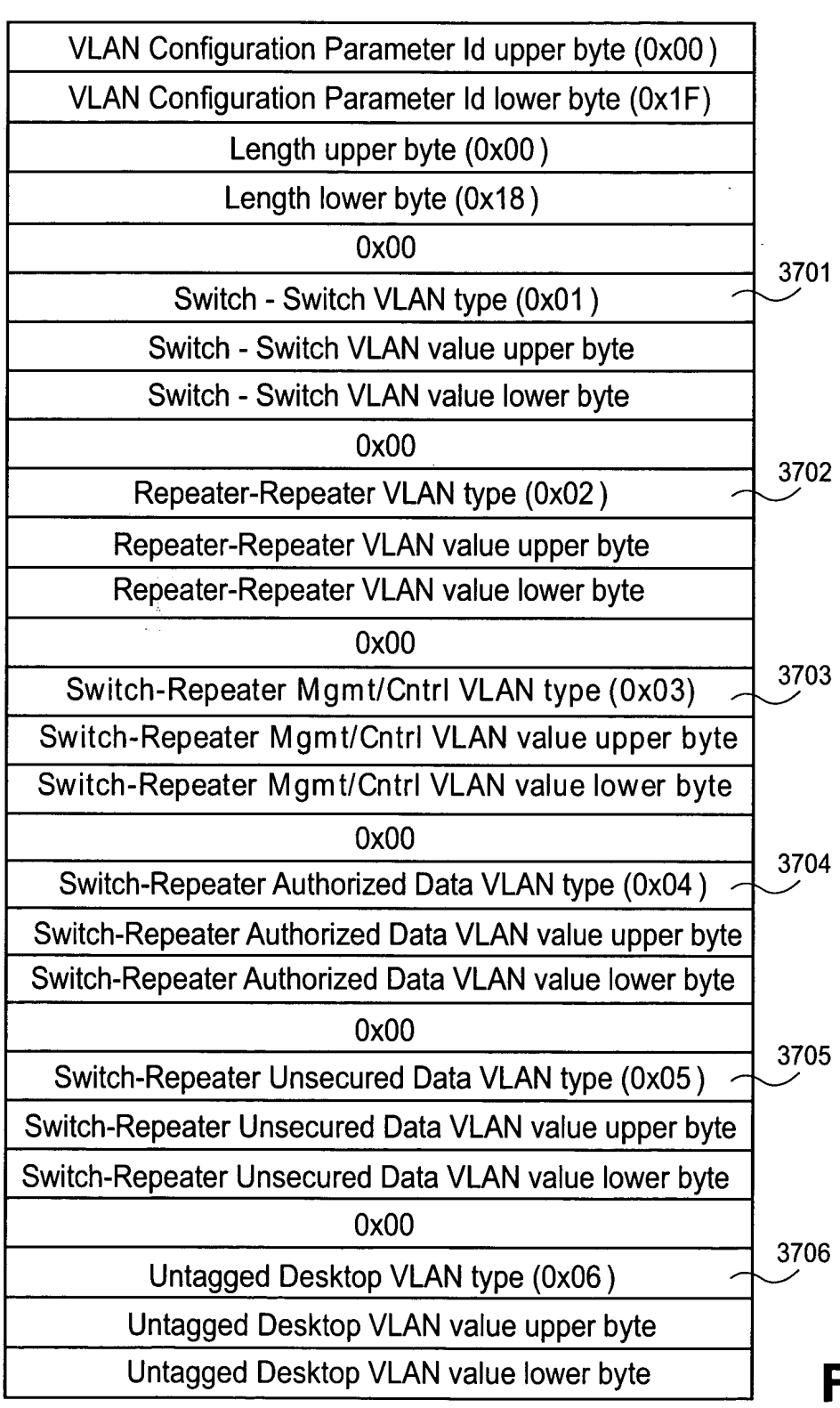
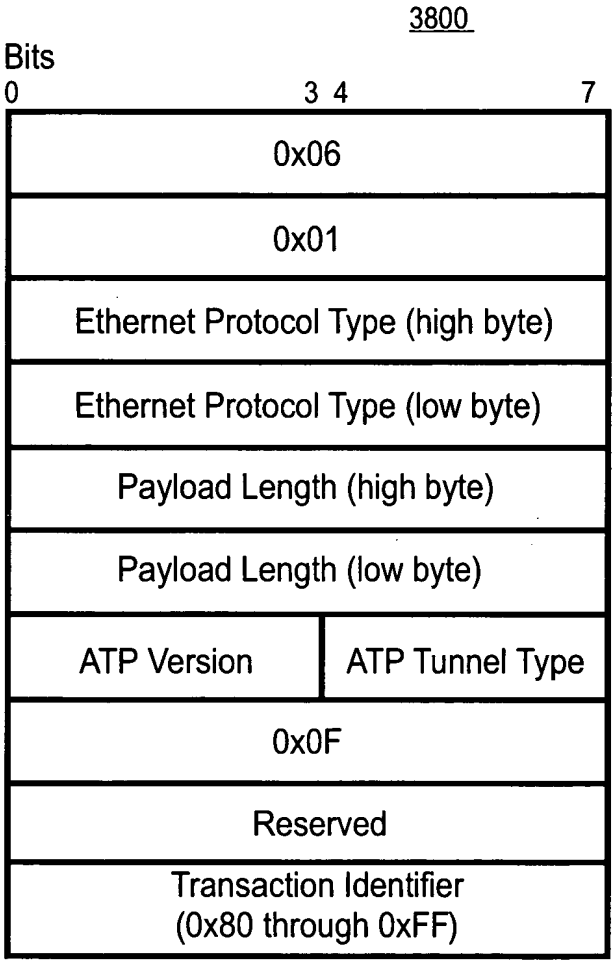
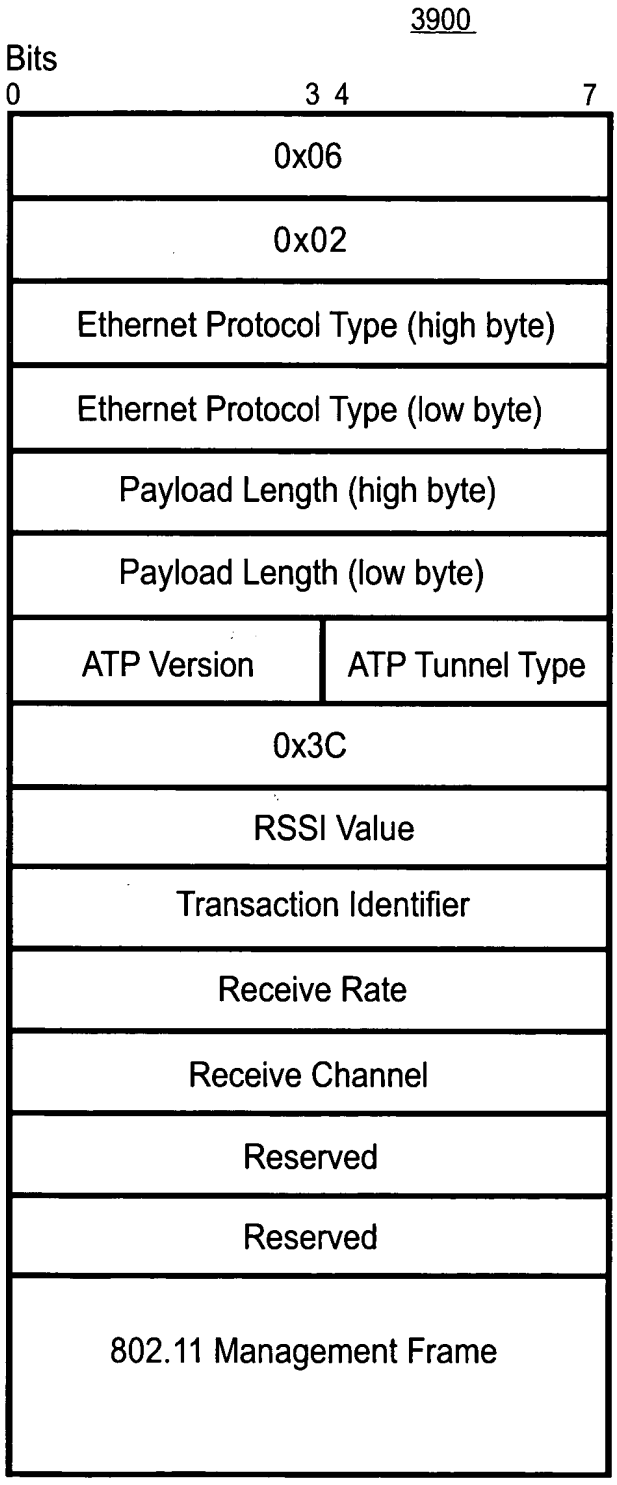

3700
VLAN Configuration Parameter Id upper byte (0x00)
VLAN Configuration Parameter Id lower byte (0x1F)
Length upper byte (0x00)
Length lower byte (0x18)
0x00
Switch - Switch VLAN type (0x01)
3701
Switch - Switch VLAN value upper byte
Switch - Switch VLAN value lower byte
0x00
Repeater-Repeater VLAN type (0x02)
3702
Repeater-Repeater VLAN value upper byte
Repeater-Repeater VLAN value lower byte
0x00
Switch-Repeater Mgmt/Cntrl VLAN type (0x03)
3703
Switch-Repeater Mgmt/Cntrl VLAN value upper byte
Switch-Repeater Mgmt/Cntrl VLAN value lower byte
0x00
Switch-Repeater Authorized Data VLAN type (0x04)
3704
Switch-Repeater Authorized Data VLAN value upper byte
Switch-Repeater Authorized Data VLAN value lower byte
0x00
Switch-Repeater Unsecured Data VLAN type (0x05)
3705
Switch-Repeater Unsecured Data VLAN value upper byte
Switch-Repeater Unsecured Data VLAN value lower byte
0x00
Untagged Desktop VLAN type (0x06)
3706
Untagged Desktop VLAN value upper byte
Untagged Desktop VLAN value lower byte

FIG. 37



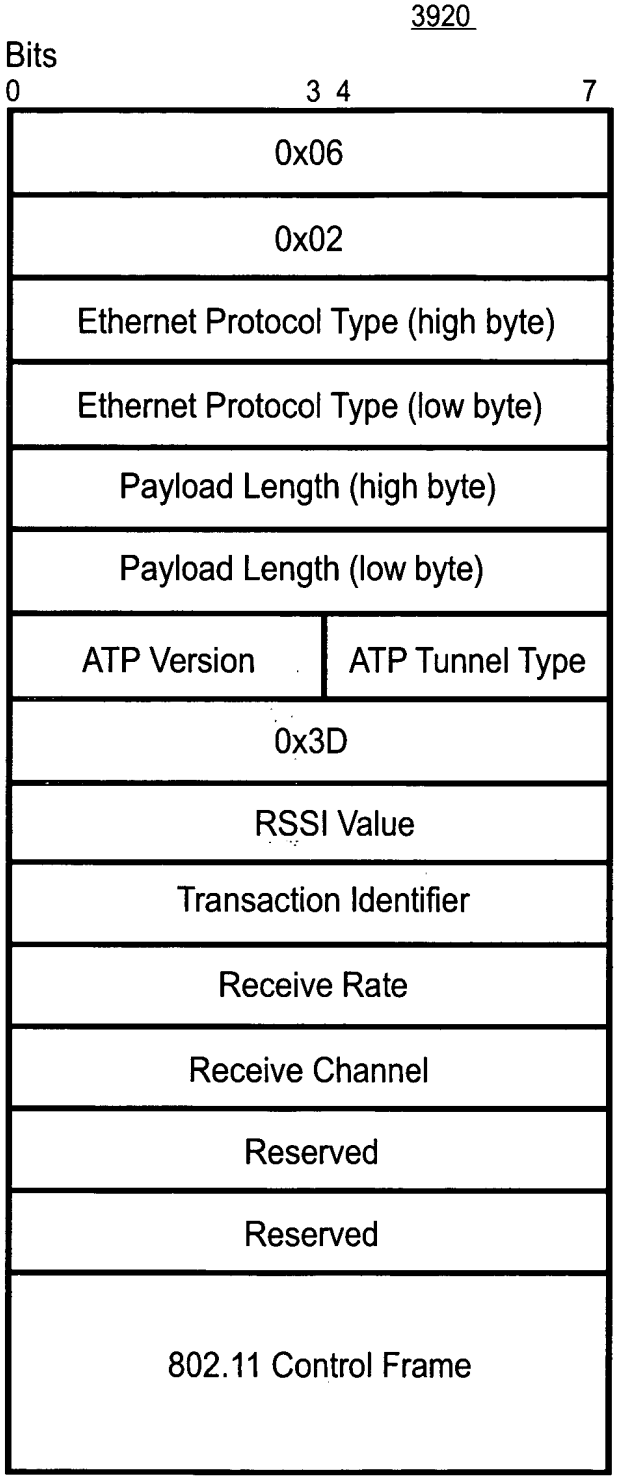
Repeater Acknowledgment Frame Format

FIG. 38



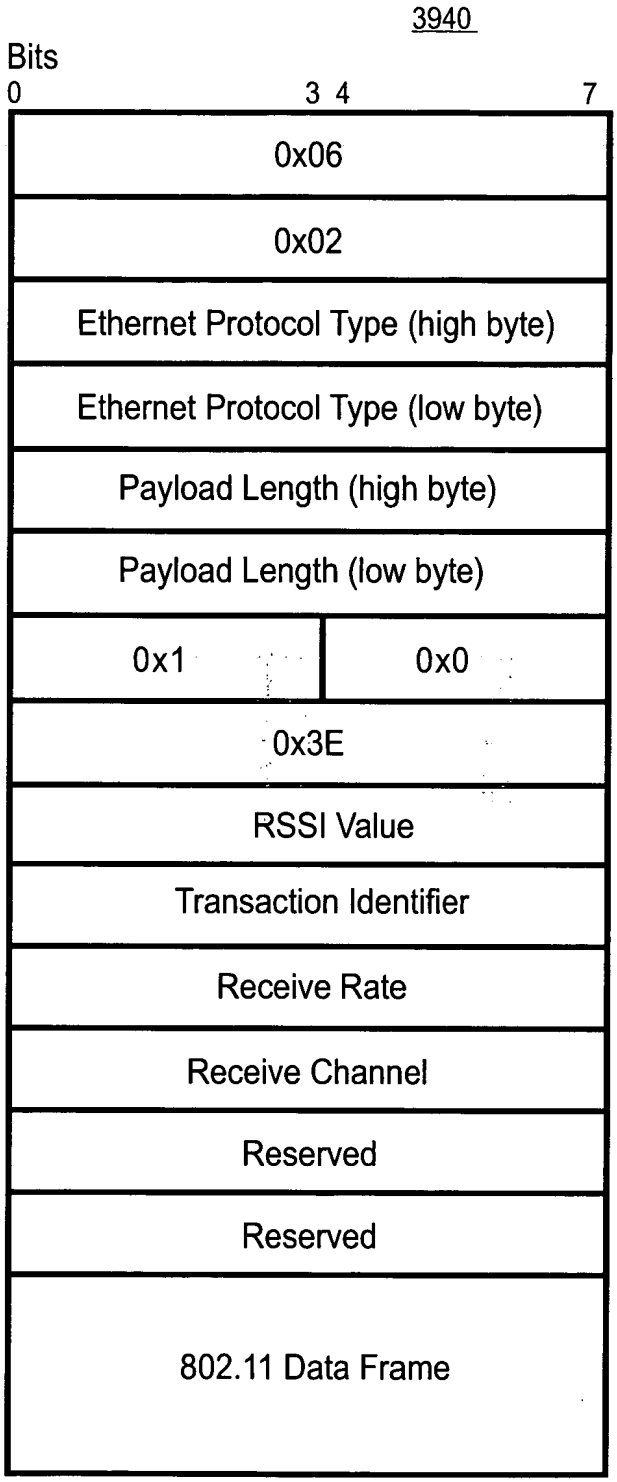
Inbound 802.11 Management Frame Format

FIG. 39A



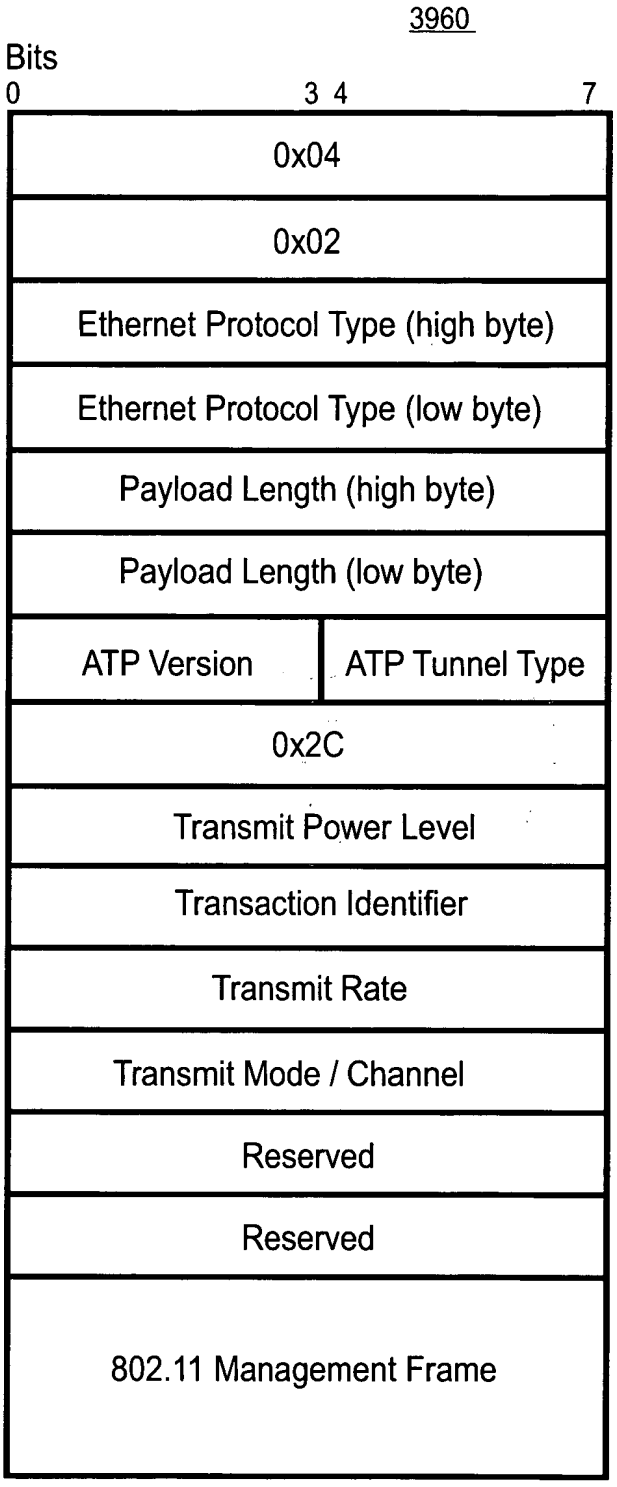
Inbound 802.11 Control Frame Format

FIG. 39B



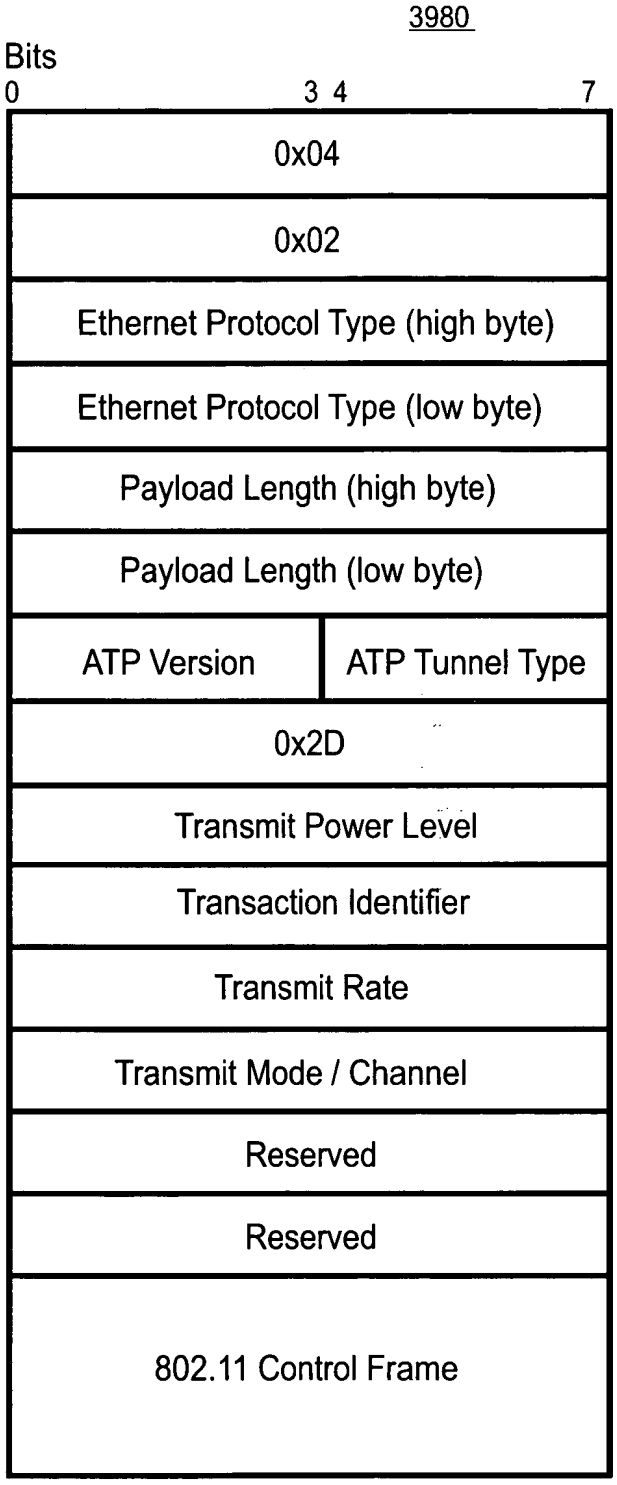
Inbound 802.11 Data Frame Format

FIG. 39C



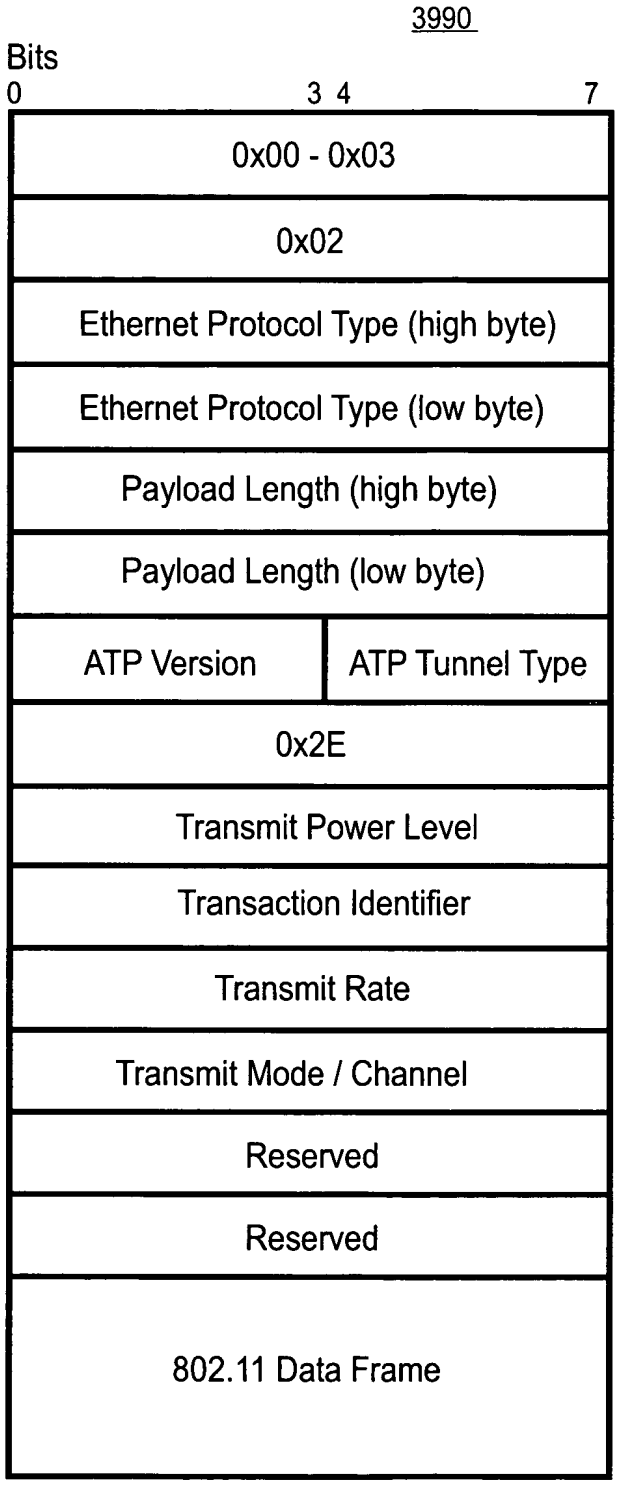
Outbound 802.11 Management Frame Format

FIG. 39D



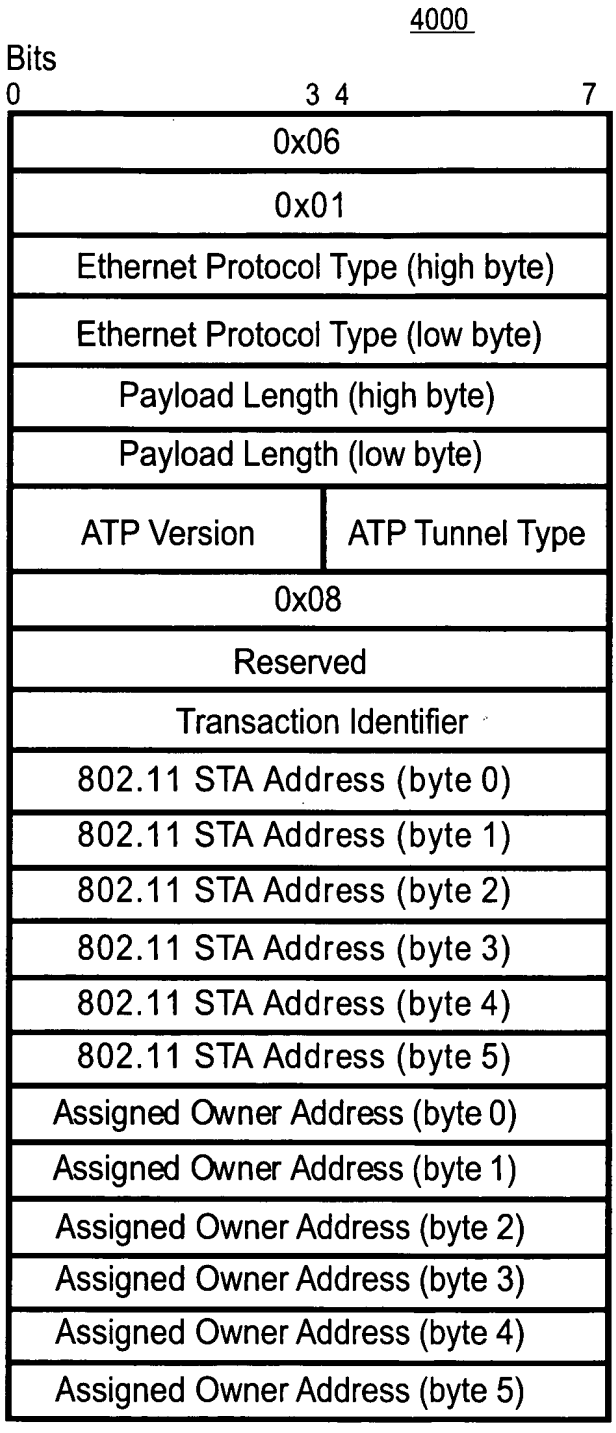
Outbound 802.11 Control Frame Format

FIG. 39E



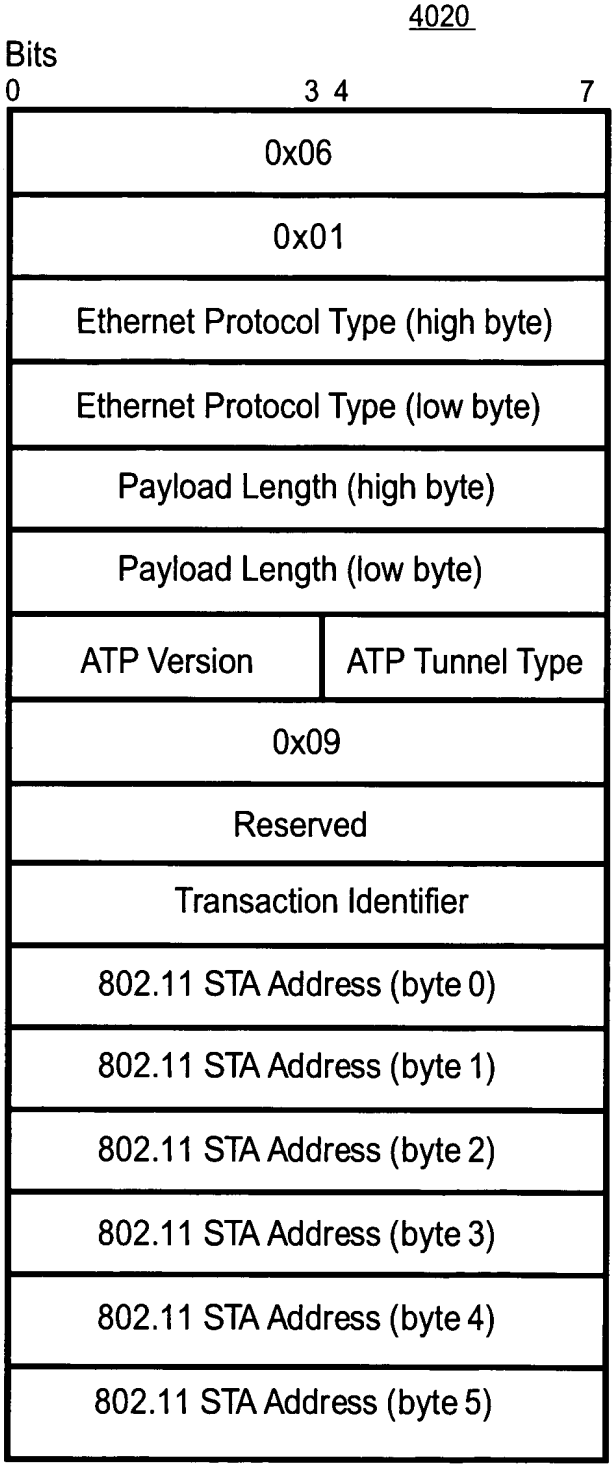
Outbound 802.11 Data Frame Format

FIG. 39F



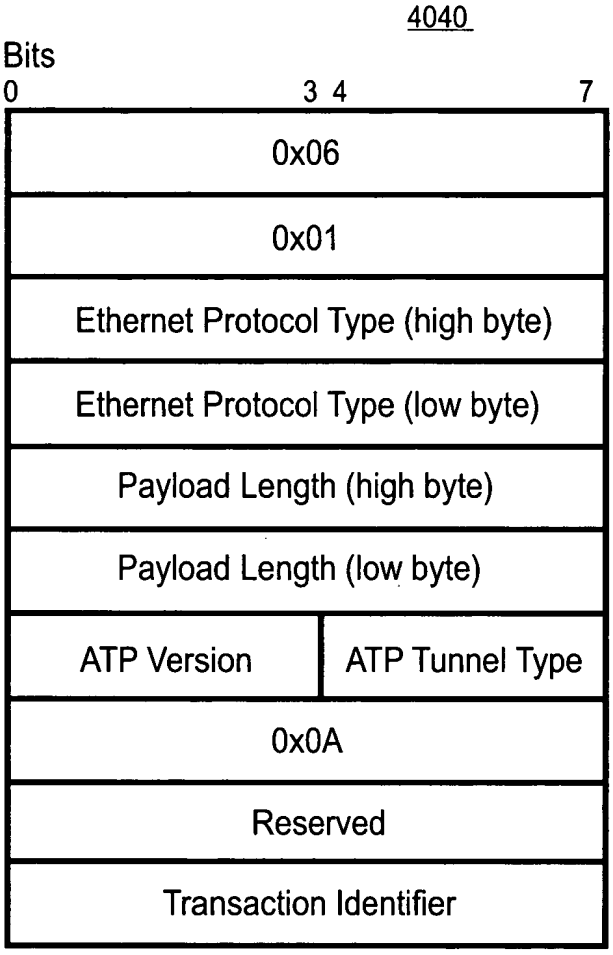
Assign Token Frame Format

FIG. 40A



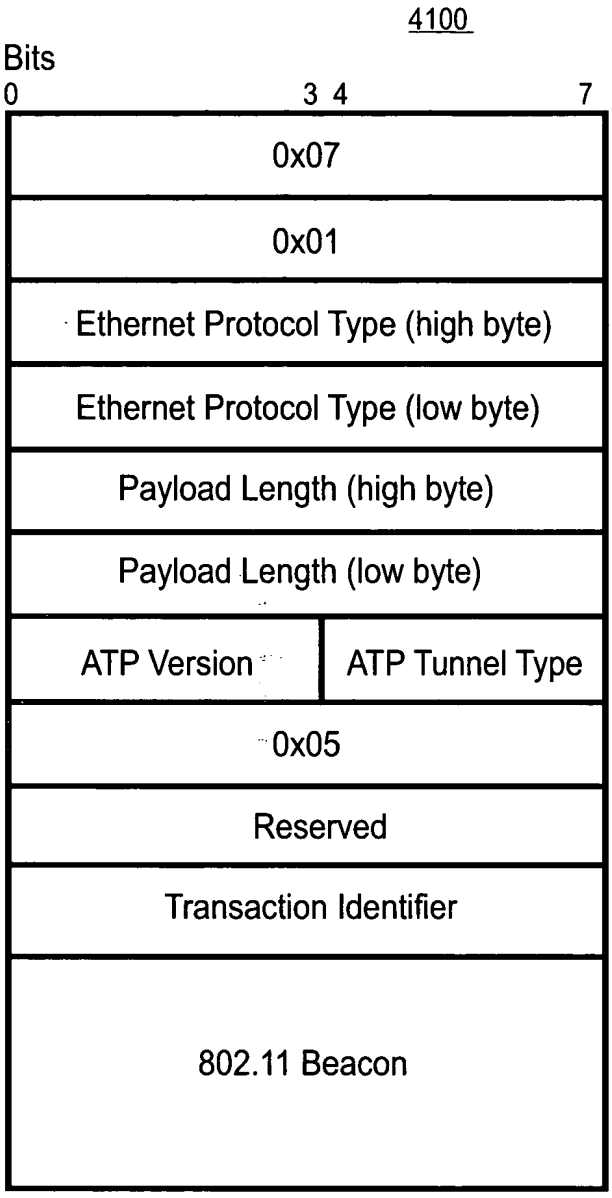
Delete Token Frame Format

FIG. 40B



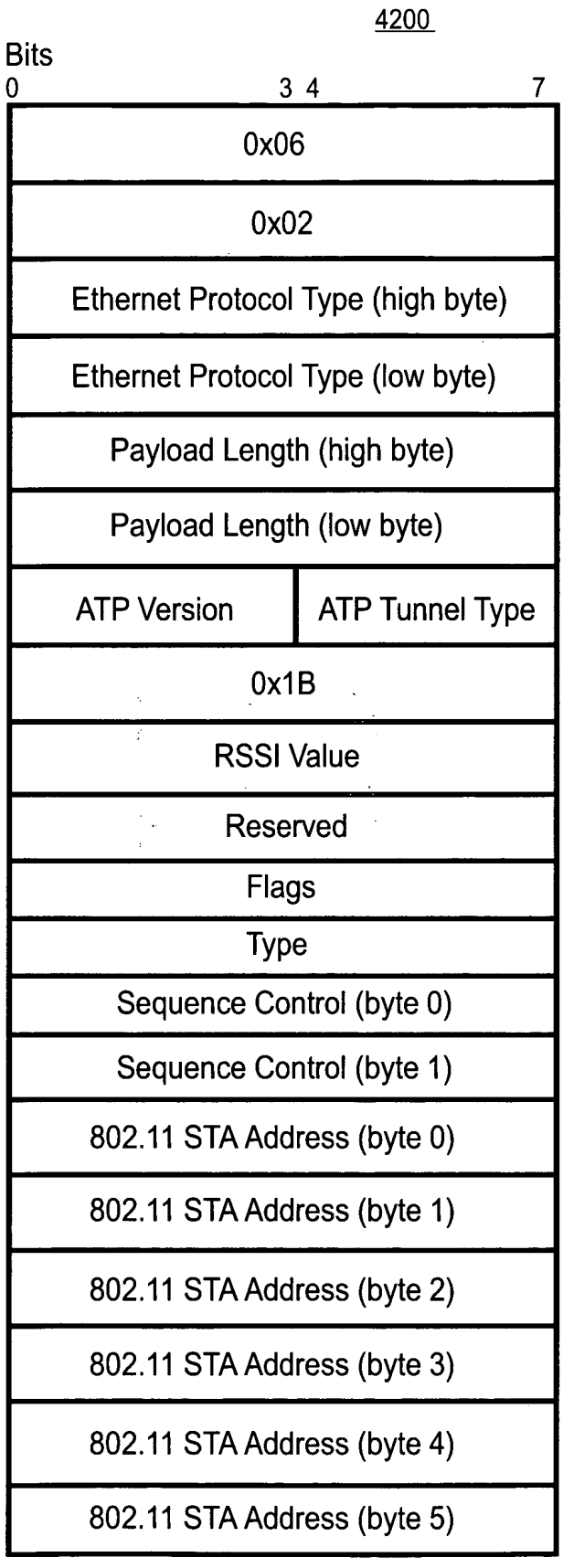
Token List Query Frame Format

FIG. 40C



Beacon Message

FIG. 41



RSSI Information Message Frame Format

FIG. 42